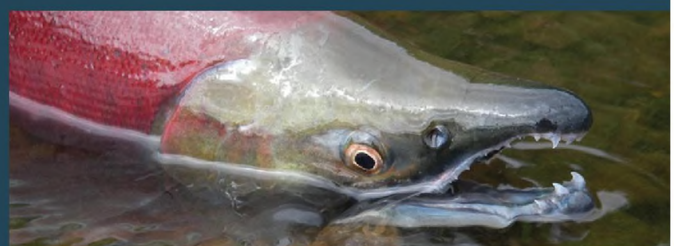
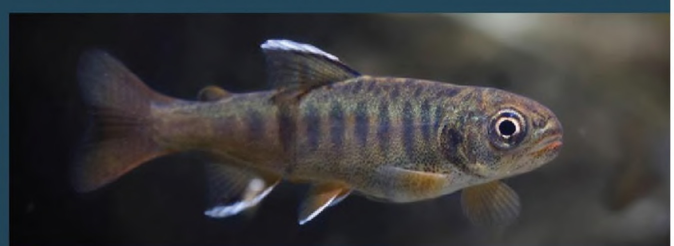
United States Environmental Protection Agency

January 2023

Final Determination of the U.S. Environmental Protection Agency Pursuant to Section 404(c) of the Clean Water Act

Pebble Deposit Area, Southwest Alaska





Office of Water, Washington, DC
www.epa.gov/bristolbay

January 2023

FINAL DETERMINATION OF THE U.S ENVIRONMENTAL PROTECTION AGENCY PURSUANT TO SECTION 404(C) OF THE CLEAN WATER ACT PEBBLE DEPOSIT AREA, SOUTHWEST ALASKA

U.S. Environmental Protection Agency
Office of Water

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Acronyms and Abbreviations

AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
AFFI	Alaska Freshwater Fish Inventory
ANCSA	Alaska Native Claims Settlement Act
ANILCA	Alaska National Interest Lands Conservation Act
AS	Alaska Statute
ASA	Alaska Statehood Act
AWC	Anadromous Waters Catalog
BBA	Bristol Bay Assessment
BBAP	Bristol Bay Area Plan for State Lands
BBMA	Bristol Bay Sport Fish Management Area
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CILEA	Cook Inlet Land Exchange Act
CMP	Compensatory Mitigation Plan
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FMEA	Failure Modes Effects Analysis
FR	Federal Register
HUC	Hydrologic Unit Code
ITEK	indigenous traditional ecological knowledge
LEDPA	Least Environmentally Damaging Practicable Alternative
MCO	Mineral Closing Order
ML	metal leaching
MDN	marine-derived nutrients
MOA	Memorandum of Agreement
NDM	Northern Dynasty Minerals, Ltd.
NEPA	National Environmental Policy Act
NFK	North Fork Koktuli River
NHD	National Hydrography Dataset
NMFS	National Marine Fisheries Service
NPS	National Park Service
NWI	National Wetlands Inventory
PAG	potentially acid-generating
PLP	Pebble Limited Partnership
RAP	Riverscape Analysis Project
RFI	Request For Information
ROD	Record of Decision

SEC	U.S. Securities and Exchange Commission
Secretary	Secretary of the Army
SFK	South Fork Koktuli River
TEK	traditional ecological knowledge
TSF	tailings storage facility
TSS	total suspended solids
USACE	U.S. Army Corps of Engineers
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTC	Upper Talarik Creek
WMP	water management pond
WQC	water quality criteria
WTP	water treatment plant

Cover Photo Credits

Main photo: Upper Talarik Creek (Joe Ebersole, USEPA)
Thumbnail 1: Fishing boats at Naknek, Alaska (USEPA)
Thumbnail 2: Sockeye salmon in the Wood River (Thomas Quinn, University of Washington)
Thumbnail 3: Salmon drying at Koliganek (Alan Boraas, Kenai Peninsula College)
Thumbnail 4: Age-0 coho salmon in the Chignik watershed (Jonny Armstrong)

EXECUTIVE SUMMARY

The U.S. Environmental Protection Agency (EPA) is prohibiting the specification of and restricting the use for specification of certain waters in the Bristol Bay watershed as disposal sites for certain discharges of dredged or fill material associated with development of a mine at the Pebble deposit, a large ore body in southwest Alaska. EPA is exercising its authority under Section 404(c) of the Clean Water Act (CWA) (Box ES-1) and its implementing regulations at 40 Code of Federal Regulations (CFR) Part 231 because the discharges of dredged or fill material associated with developing a mine evaluated in this final determination will have unacceptable adverse effects on anadromous[1] fishery areas in the Bristol Bay watershed. Development of a mine at the Pebble deposit has been the subject of study for more than two decades. This final determination is based on this extensive record of scientific and technical information and applies only to certain discharges of dredged or fill material associated with developing the Pebble deposit, not to any other resource development projects in the State of Alaska.

Alaska's Bristol Bay watershed (Figure ES-1) is an area of unparalleled ecological value, boasting salmon diversity and productivity unrivaled anywhere in North America. The Bristol Bay watershed provides intact, connected habitats—from headwaters to ocean—that support abundant, genetically diverse wild Pacific salmon populations. These salmon populations, in turn, help to maintain the productivity of the entire ecosystem, including numerous other fish and wildlife species. The region's salmon resources have supported Alaska Native cultures for thousands of years and continue to support one of the last intact salmon-based cultures in the world. Together, the Bristol Bay watershed's largely undisturbed aquatic habitats and productive salmon populations create this globally significant ecological and cultural resource.

The streams, wetlands, and other aquatic resources of the Bristol Bay watershed also provide the foundation for world-class, economically important, commercial and sport fisheries for salmon and other fishes. The Bristol Bay watershed supports the world's largest runs of Sockeye Salmon, producing approximately half of the world's Sockeye Salmon. These Sockeye Salmon represent the most abundant and diverse populations of this species remaining in the United States. Bristol Bay's Chinook Salmon runs are also frequently at or near the world's largest, and the region also supports significant Coho, Chum, and Pink salmon populations. Because no hatchery fishes are raised or released in the watershed, Bristol Bay's salmon populations are entirely wild and self-sustaining. Bristol Bay is remarkable as one of the last places on Earth with such bountiful and sustainable harvests of wild salmon. One of the main factors leading to the success of these fisheries is the fact that its diverse aquatic habitats are largely untouched and pristine, unlike the waters that support many other salmon fisheries worldwide.

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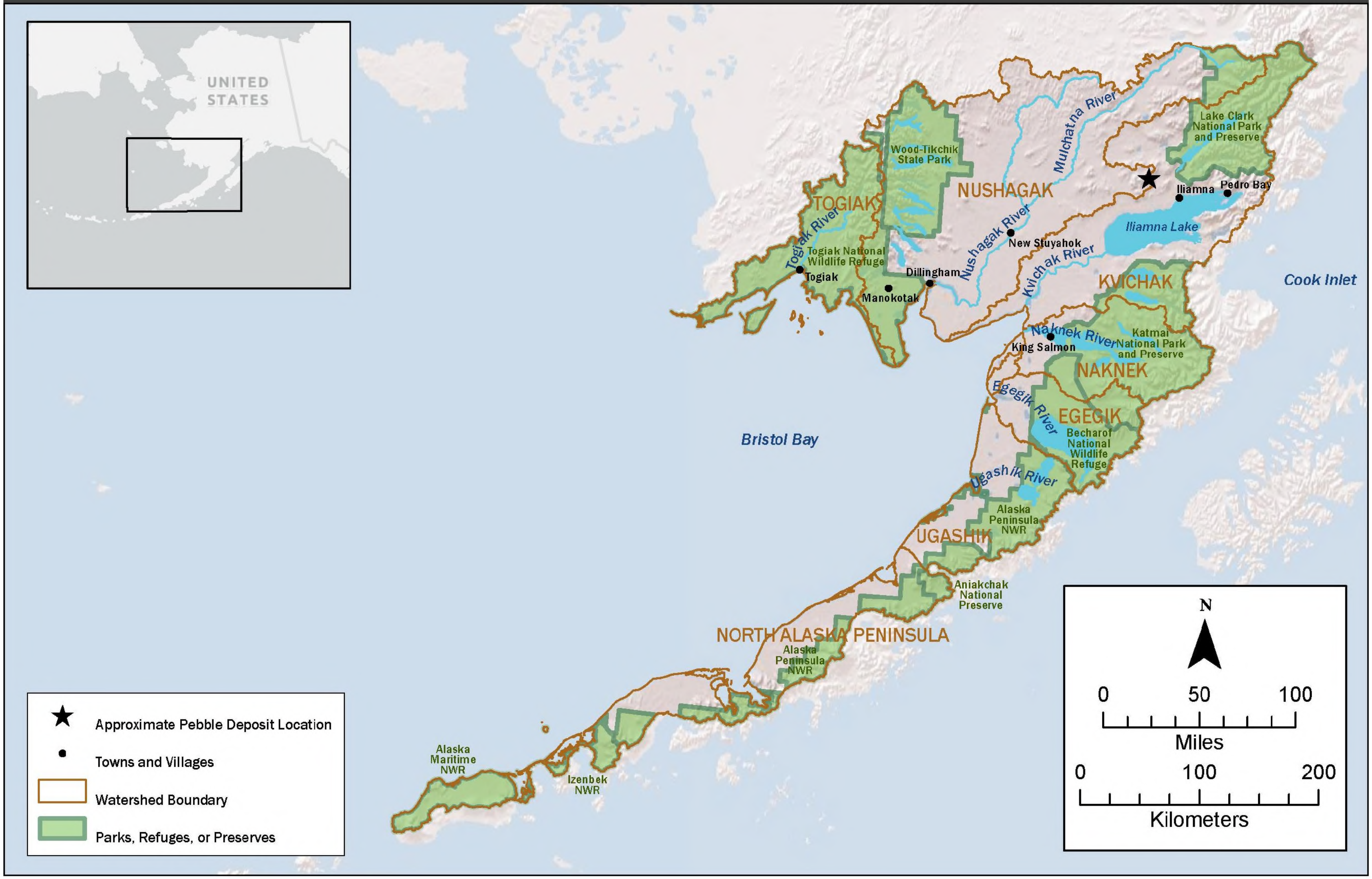
[1] Anadromous fishes hatch in freshwater habitats, migrate to sea for a period of relatively rapid growth, and then return to freshwater habitats to spawn. For the purposes of this final determination, "anadromous fishes" refers only to Coho or Silver salmon (*Oncorhynchus kisutch*), Chinook or King salmon (*O. tshawytscha*), Sockeye or Red salmon (*O. nerka*), Chum or Dog salmon (*O. keta*), and Pink or Humpback salmon (*O. gorbuscha*).

Figure ES-1. The Bristol Bay watershed, composed of the Togiak, Nushagak, Kvichak, Naknek, Egegik, and Ugashik River watersheds and the North Alaska Peninsula. Only selected towns and villages are shown on this map.



Roughly 50 to 70 percent of Bristol Bay's Sockeye and large numbers of its Coho, Chinook, Pink, and Chum salmon are sustainably harvested in subsistence, commercial, and recreational fisheries before they can return to their natal lakes and streams to spawn. Thus, these salmon resources have significant nutritional, cultural, economic, and recreational value within and beyond the Bristol Bay region. The total economic value of the Bristol Bay watershed's salmon resources, including subsistence uses, was estimated at more than $2.2 billion in 2019 (McKinley Research Group 2021). The Bristol Bay commercial salmon fishery generates the most significant component of this economic activity, resulting in 15,000 jobs and an economic benefit of $2.0 billion in 2019, $990 million of which was in Alaska (McKinley Research Group 2021). Beyond their economic and environmental value, the diverse fishery and other aquatic and terrestrial resources of the Bristol Bay watershed, which depend upon the complex of healthy streams, wetlands, and other waters, are irreplaceable because they are inseparable from the cultures of the native people they support. Section 3 of this final determination provides an overview of the streams, wetlands, and other aquatic resources of the Bristol Bay watershed and discusses their role in supporting important subsistence, commercial, and recreational fisheries.

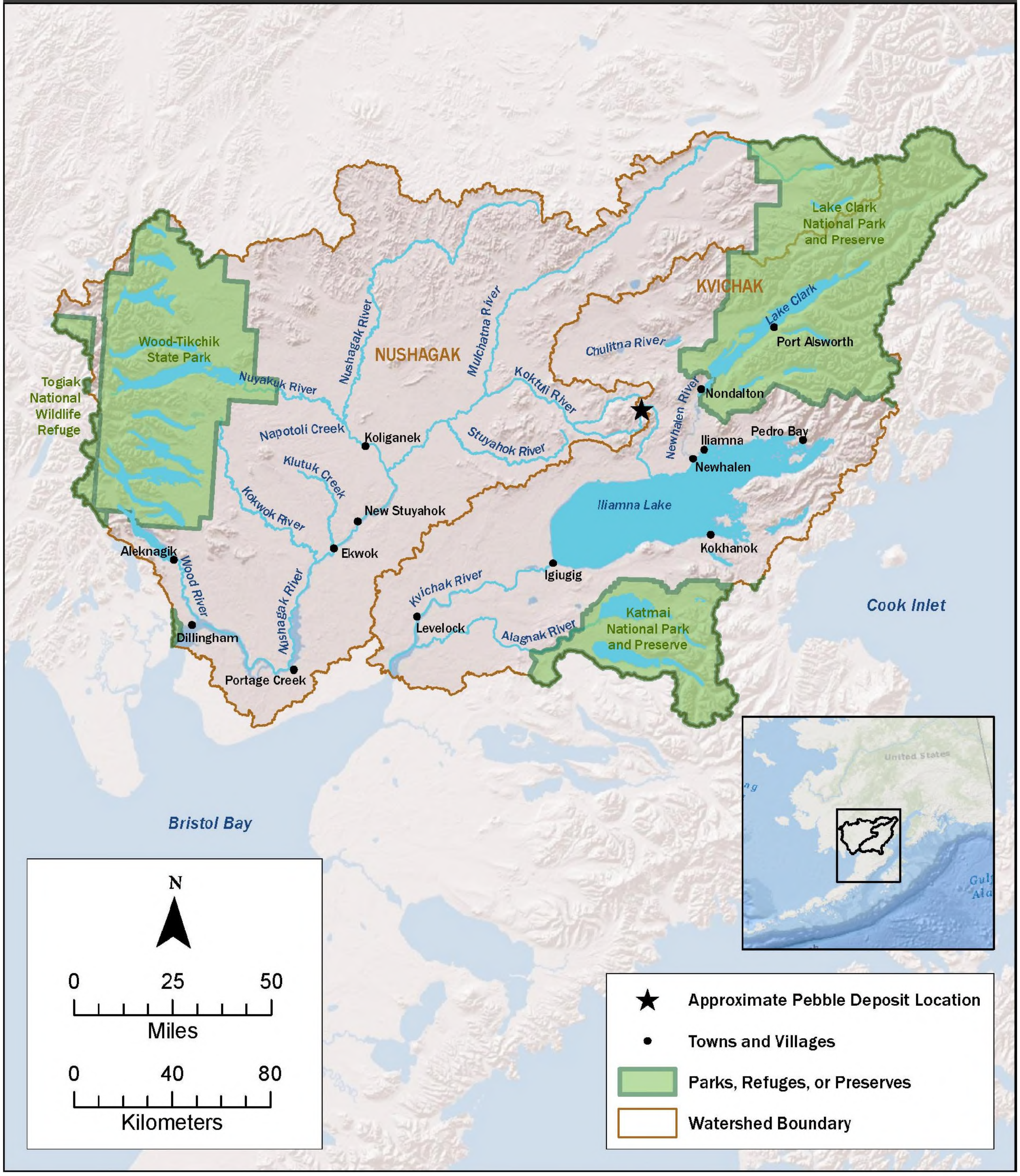
BOX ES-1. SECTION 404 OF THE CLEAN WATER ACT

The objective of the Clean Water Act (CWA) is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. Section 404(c) of the CWA authorizes the U.S. Environmental Protection Agency (EPA) to (1) prohibit or withdraw the specification of any defined area as a disposal site, and (2) deny, restrict, or withdraw the use of any defined area for specification as a disposal site, whenever it determines, after notice and opportunity for public hearings, that the discharge of dredged or fill material into the area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas. EPA has used its CWA Section 404(c) authority judiciously, having completed only 13 CWA Section 404(c) actions in the 50-year history of the CWA prior to this final determination.

Proposed Mine at the Pebble Deposit

The Pebble deposit, a large, low-grade deposit containing copper-, gold-, and molybdenum-bearing minerals, is located at the headwaters of the pristine Bristol Bay watershed. The Pebble deposit underlies portions of the South Fork Koktuli River (SFK), North Fork Koktuli River (NFK), and Upper Talarik Creek (UTC) watersheds, which drain to two of the largest rivers in the Bristol Bay watershed, the Nushagak and Kvichak Rivers (Figure ES-2).

Figure ES-2. Major waterbodies within the Nushagak and Kvichak River watersheds.



Since 2001, Northern Dynasty Minerals Ltd. (NDM) and subsequently the Pebble Limited Partnership (PLP)[2] have been conducting data collection and analysis as part of efforts to pursue the development of a large-scale mine at the Pebble deposit. Given current mining technology and the high density of water resources in the area, the discharge of dredged or fill material into waters of the United States is expected to be necessary to develop the Pebble deposit. Such discharges would require a CWA Section 404 permit from the U.S. Army Corps of Engineers (USACE). In December 2017, PLP submitted a CWA Section 404 permit application to USACE to develop a mine at the Pebble deposit, which triggered the development of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA). In response to the CWA Section 404 permit review/NEPA review process, PLP submitted a revised permit application in June 2020 (the 2020 Mine Plan) (PLP 2020b).

In the 2020 Mine Plan, PLP proposes to develop the Pebble deposit as a surface mine at which 1.3 billion tons of ore would be mined over 20 years. The project consists of four primary elements: (1) the mine site situated in the SFK, NFK, and UTC watersheds (Figure ES-3); (2) the Diamond Point port; (3) the transportation corridor, including concentrate and water return pipelines; and (4) the natural gas pipeline and fiber optic cable. The first element, a fully developed mine site, would include an open pit, bulk tailings storage facility (TSF), pyritic TSF, a 270-megawatt power plant, water management ponds (WMPs), water treatment plants (WTPs), milling and processing facilities, and supporting infrastructure (Figure ES-4). Under the 2020 Mine Plan, PLP would progress through four distinct mine phases: construction, operations (also referred to as production), closure, and post-closure. The construction period would last approximately four years, followed by 20 years of operation. Closure, including physical reclamation of the mine site, is projected to take approximately 20 years. Post-closure activities, including long-term water management and monitoring, would last for centuries (USACE 2020a). The potential direct and indirect impacts from construction and operation of the 2020 Mine Plan on streams, wetlands, and other waters across the mine site area (Figure ES-5) have been evaluated in detail.

On July 24, 2020, USACE published a Notice of Availability for the Final EIS (FEIS) in the *Federal Register* (USACE 2020a), and on November 20, 2020, USACE issued its Record of Decision (ROD) denying PLP's CWA Section 404 permit application on the basis that the 2020 Mine Plan would not comply with the CWA Section 404(b)(1) Guidelines and would be contrary to the public interest (USACE 2020b). By letter dated November 25, 2020, USACE notified PLP that the proposed project failed to comply with the CWA Section 404(b)(1) Guidelines because, even after consideration of proposed mitigation measures, "the proposed project would cause unavoidable adverse impacts to aquatic resources which would result in Significant Degradation to aquatic resources" (USACE 2020b: Transmittal Letter, Page 1).

On January 19, 2021, PLP filed a request for an appeal of the USACE permit denial with USACE. USACE accepted the appeal on February 25, 2021, and review of the appeal is ongoing.

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[2] PLP was created in 2007 by co-owners NDM and Anglo American PLC to design, permit, construct, and operate a long-life mine at the Pebble deposit (Ghaffari et al. 2011). In 2013, NDM acquired Anglo American's interest in PLP, and NDM now holds a 100 percent interest in PLP (Kalanchey et al. 2021).

Figure ES-3. Mine site hydrography. Figure 2-1 from PLP's June 8, 2020 Clean Water Act Section 404 permit application (PLP 2020b).

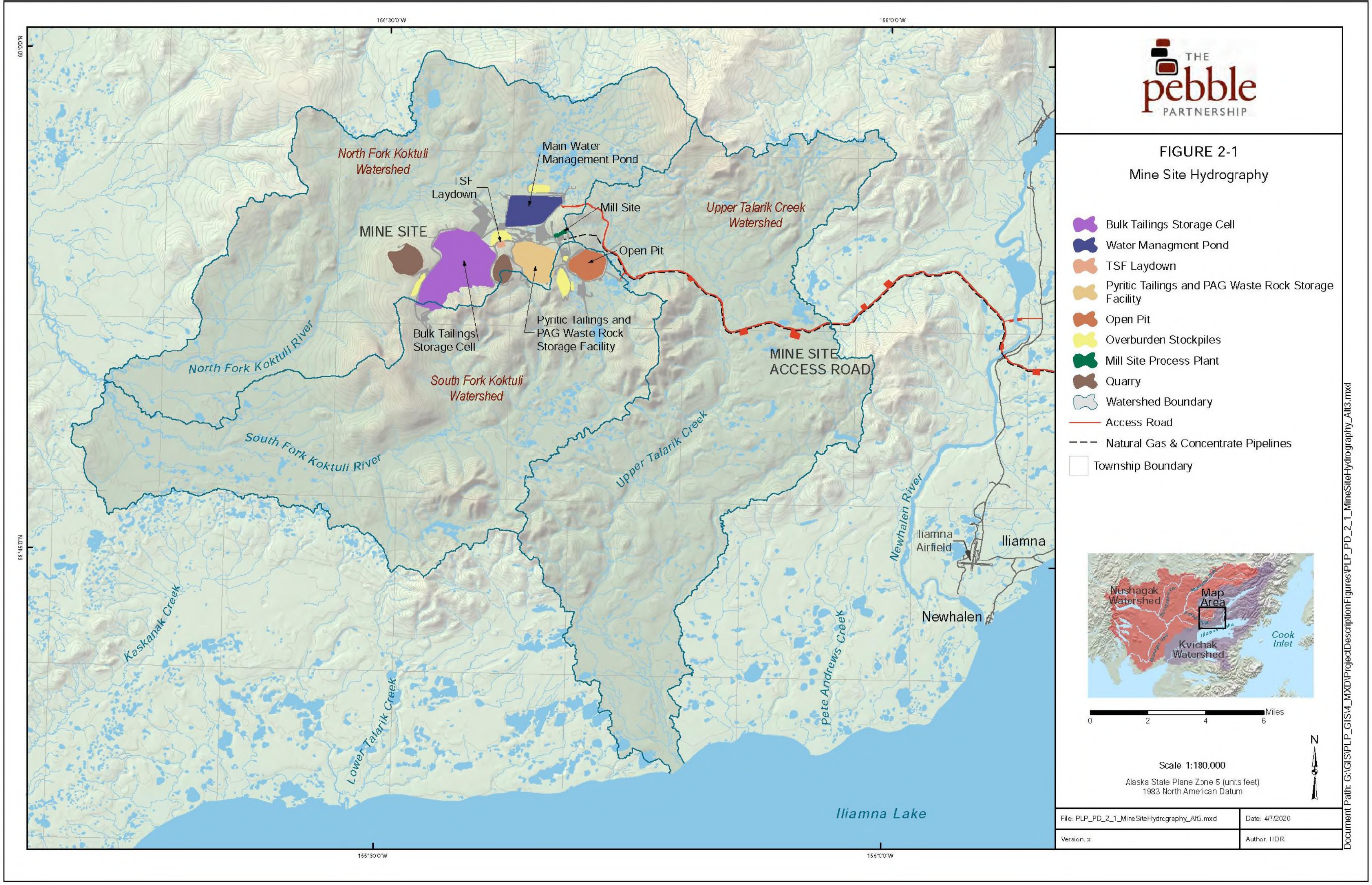


Figure ES-4. Mine site map. Figure 1-4 from PLP's June 8, 2020 Clean Water Act Section 404 permit application (PLP 2020b).

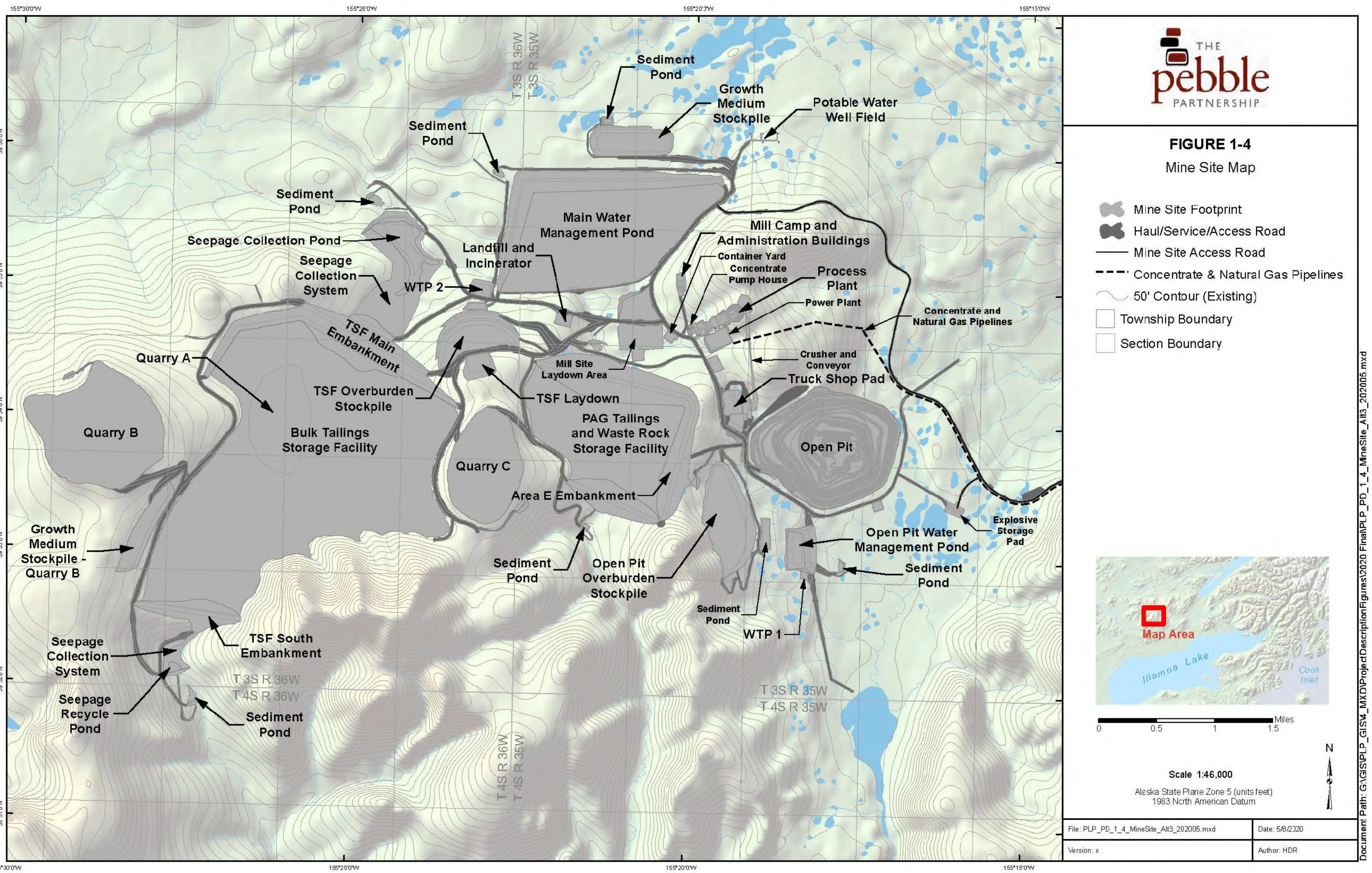
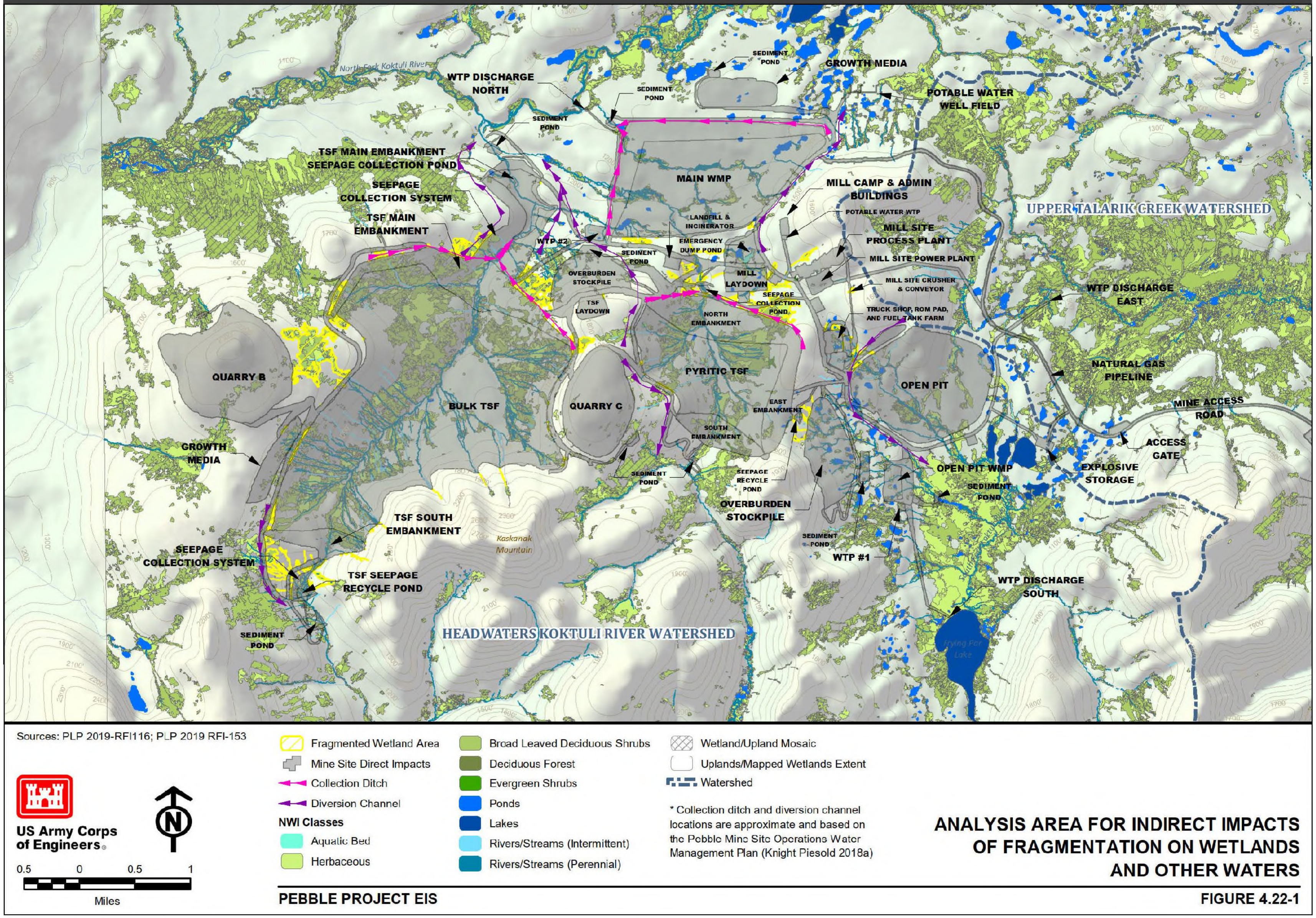


Figure ES-5. Mine site analysis area for wetlands and other waters. Figure 4.22-1 from the FEIS (USACE 2020a: Section 4.22).



The USACE permit denial addresses only PLP's specific permit application for the 2020 Mine Plan; it does not address any other potential plans to develop the Pebble deposit. Information regarding the Pebble deposit and the 2020 Mine Plan can be found in Section 2 of this final determination.

2014 Proposed Determination

For more than a decade, many Alaska Native communities in the Bristol Bay watershed; subsistence, commercial, and recreational fishing interests; conservation groups; and others have raised concerns about the potential impacts that a large-scale mine at the Pebble deposit could have on the region's socially, ecologically, and economically important fishery areas. Starting in May 2010, these groups and others began requesting that EPA use its CWA Section 404(c) authority to protect the region's fishery areas. In February 2011, EPA decided to conduct an ecological risk assessment before considering additional steps. In January 2014, after three years of study, two rounds of public comment, and independent, external peer review, EPA released its *Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska*[3] (Bristol Bay Assessment or BBA) (EPA 2014). In July 2014, after careful consideration of available information, including the findings of the BBA and consultation with PLP and the State of Alaska, EPA Region 10 published a proposed determination under Section 404(c) of the CWA to restrict the use of certain waters in the SFK, NFK, and UTC watersheds as disposal sites for dredged or fill material associated with mining the Pebble deposit (2014 Proposed Determination) for public comment.

As a result of litigation brought by PLP, EPA Region 10's CWA Section 404(c) review process was halted in November 2014 until EPA and PLP resolved the case in a May 2017 settlement agreement. As a condition of that settlement agreement, EPA Region 10 initiated a process to propose to withdraw the 2014 Proposed Determination, and EPA ultimately withdrew the 2014 Proposed Determination in August 2019. In October 2019, 20 tribal, fishing, environmental, and conservation groups challenged EPA's withdrawal of the 2014 Proposed Determination. The ultimate result of the litigation that began in October 2019 was an October 29, 2021 decision by the U.S. District Court for the District of Alaska to vacate EPA's 2019 decision to withdraw the 2014 Proposed Determination and remand the action to the Agency for reconsideration.

The District Court's vacatur of EPA's 2019 decision to withdraw the 2014 Proposed Determination had the effect of reinstating the 2014 Proposed Determination and reinitiating EPA's CWA Section 404(c) review process. The next step in the CWA Section 404(c) review process required the Region 10 Regional Administrator to decide whether to withdraw the 2014 Proposed Determination or prepare a recommended determination within 30 days. On November 23, 2021, EPA Region 10 published in the *Federal Register* a notice extending the applicable time requirement through May 31, 2022, to provide sufficient time to consider available information and determine the appropriate next step in the CWA

[3] EPA conducted the BBA consistent with its authority under CWA Section 104(a) and (b). For more information about EPA's efforts in Bristol Bay or copies of the Bristol Bay Assessment, see http://www.epa.gov/bristolbay.

Section 404(c) review process. In its notice, EPA concluded that it should consider information that had become available since EPA issued the 2014 Proposed Determination before making a decision. Information regarding the 2014 Proposed Determination and the history of EPA's work in the Bristol Bay watershed can be found in Section 2 of this final determination.

2022 Proposed Determination

To determine the appropriate next step in this CWA Section 404(c) process, EPA Region 10 considered a wide array of information that had become available since it issued the 2014 Proposed Determination, including the following:

- More than 670,000 public comments submitted to EPA Region 10 in response to the 2014 Proposed Determination.
- PLP's CWA Section 404 permit application, including the 2020 Mine Plan (PLP 2020b).
- USACE's FEIS evaluating the 2020 Mine Plan, including the FEIS appendices, technical support documents, and references (USACE 2020a).
- The 12-week coordination process between EPA, the U.S. Fish and Wildlife Service, and USACE in spring 2020 to evaluate PLP's proposed project for compliance with the CWA Section 404(b)(1) Guidelines.
- USACE's ROD denying PLP's CWA Section 404 permit application for the 2020 Mine Plan, including the ROD supporting documents (USACE 2020b).
- NDM's *Pebble Project Preliminary Economic Assessment* dated September 9, 2021 (Kalanchey et al. 2021).
- Updated data regarding fishery resources in the Bristol Bay watershed.
- New scientific and technical publications.

In January 2022, consistent with its regulatory procedures for proposed determinations at 40 CFR 231.3(a), EPA Region 10 notified USACE, the Alaska Department of Natural Resources (ADNR), PLP, Pebble East Claims Corporation, Pebble West Claims Corporation, and Chuchuna Minerals[4] (the Parties) of EPA Region 10's intention to issue a revised proposed determination because, based on a review of information available to that date, it continued to believe that the discharge of dredged or fill material associated with mining the Pebble deposit could result in unacceptable adverse effects on important fishery areas. EPA Region 10 provided the Parties with an opportunity to consult with the Region and to submit information for the record to demonstrate that no unacceptable adverse effects would result

[4] EPA Region 10 notified Chuchuna Minerals because USACE's FEIS for the 2020 Mine Plan indicates that it is reasonably foreseeable for discharges associated with mining the Pebble deposit to expand in the future into portions of areas where Chuchuna Minerals holds mining claims.

from discharges associated with mining the Pebble deposit or that actions could be taken to prevent unacceptable adverse effects on important fishery areas.

ADNR, PLP, and Chuchuna Minerals submitted response letters asserting legal, policy, scientific, and technical arguments, and EPA met individually with PLP and Chuchuna Minerals. Based on the information provided to the Agency, ADNR, PLP, and Chuchuna Minerals did not demonstrate to the satisfaction of EPA Region 10 that no unacceptable adverse effects would occur as a result of the discharge of dredged or fill material associated with mining the Pebble deposit (Section 2.2.2). Thus, EPA Region 10 decided that the appropriate next step in this CWA Section 404(c) process was the publication of a revised proposed determination (the 2022 Proposed Determination).

In May 2022, EPA Region 10 published in the *Federal Register* a notice of availability for the 2022 Proposed Determination under Section 404(c) of the CWA to prohibit the specification of and restrict the use for specification of certain waters in the SFK, NFK, and UTC watersheds as disposal sites for the discharge of dredged or fill material associated with mining the Pebble deposit (87 FR 32021, May 26, 2022). The notice started a public comment period ending on July 5, 2022. On June 16 and 17, 2022, EPA Region 10 held three public hearings on the 2022 Proposed Determination: two in-person hearings in the Bristol Bay region (in Dillingham and Iliamna) and one virtual hearing. More than 186 people participated in the three hearings, 111 of whom provided oral statements.

EPA Region 10 received requests to extend the public comment period, as well as requests not to extend the public comment period. EPA Region 10 considered each of these requests and found good cause existed pursuant to 40 CFR 231.8 to extend the public comment period through September 6, 2022 (87 FR 39091, June 30, 2022).

On September 6, 2022, EPA Region 10 published in the *Federal Register* a notice to extend the period for the EPA Region 10 Regional Administrator to evaluate public comments. According to the notice, EPA found good cause existed pursuant to 40 CFR 231.8 to extend the time period provided in 40 CFR 231.5(a) to either withdraw the proposed determination or to prepare a recommended determination through no later than December 2, 2022, to help ensure full consideration of the extensive administrative record including all public comments (87 FR 54498, September 6, 2022). In addition to the testimony taken at the hearings, EPA Region 10 received more than 582,000 written comments during the public comment period.

EPA Region 10 completed its review of the extensive administrative record, including all public comments. The Regional Administrator determined that the discharge of dredged or fill material associated with developing the Pebble deposit would be likely to result in unacceptable adverse effects on anadromous fishery areas and, thus, prepared a recommended determination. The recommended determination, along with the administrative record, was transmitted to EPA's Assistant Administrator for Water on December 1, 2022, for review and final action.

The Final Determination

On December 2, 2022, the Assistant Administrator for Water notified the Parties[5] that she had received EPA Region 10's recommended determination and, consistent with EPA's CWA Section 404(c) regulations at 40 CFR 231.6, provided them the opportunity to notify EPA of their intent to take corrective action to prevent unacceptable adverse effects on anadromous fishery areas from certain discharges of dredged or fill material associated with developing the Pebble deposit.

ADNR and PLP submitted response letters asserting legal, policy, scientific, and technical arguments that each had previously raised during consultation with EPA prior to issuance of the proposed determination and in public comments on the proposed determination. EPA also met with ADNR and other representatives from the State of Alaska. USACE and Chuchuna Minerals also submitted response letters. None of the Parties identified corrective action to prevent unacceptable adverse effects satisfactory to the Assistant Administrator for Water. Section 2 of this final determination includes a summary of the Assistant Administrator for Water's consultation with the Parties.

Following review of EPA Region 10's recommended determination and the extensive administrative record supporting the Regional Administrator's decision, including all public comments, the Assistant Administrator for Water has determined that certain discharges of dredged or fill material associated with developing the Pebble deposit into certain waters of the United States will have unacceptable adverse effects on anadromous fishery areas and affirms the recommended determination.[6] Section 4 of this final determination provides the basis for EPA's findings regarding unacceptable adverse effects on anadromous fishery areas.

As demonstrated in the FEIS and ROD, construction and routine operation of the mine proposed in the 2020 Mine Plan would result in the discharge of dredged or fill material into waters of the United States, including streams, wetlands, lakes, and ponds overlying the Pebble deposit and within adjacent watersheds. The direct effects (i.e., resulting from placement of fill in aquatic habitats) and certain secondary effects of such discharges (i.e., associated with discharges of dredged or fill material, but not resulting from the actual placement of such material) would result in the total loss of aquatic habitats important to anadromous fishes. These losses would result from the construction and routine operation of the various components of the mine site, including the open pit, bulk TSF, pyritic TSF, power plant, WMPs, WTPs, milling/processing facilities, and supporting infrastructure. According to the FEIS and ROD, discharges of dredged or fill material to construct and operate the mine site proposed in the 2020 Mine Plan would result in the total loss of approximately 99.7 miles (160.5 km) of stream habitat, representing approximately 8.5 miles (13.7 km) of anadromous fish streams and 91 miles (147 km) of additional streams that support anadromous fish streams. Such discharges of dredged or fill material

[5] Consistent with EPA's regulations, the USACE representative who received this notification was the Chief of Engineers.

[6] EPA has made additional clarifications throughout this final determination based on EPA Office of Water's review of the recommended determination and administrative record, as well as final consultation with the Parties, conducted consistent with 40 CFR 231.6.

also would result in the total loss of approximately 2,108 acres (8.5 km^2) of wetlands and other waters in the SFK and NFK watersheds that support anadromous fish streams.

Additional secondary effects of the proposed discharges of dredged or fill material at the mine site would degrade anadromous fishery areas downstream of the mine site. Specifically, the stream, wetland, and other aquatic resource losses from the footprint of the 2020 Mine Plan would reverberate downstream, depriving downstream anadromous fish habitats of nutrients, groundwater inputs, and other ecological subsidies from lost upstream aquatic resources. Further, streamflow alterations from water capture, withdrawal, storage, treatment, or release at the mine site are another secondary effect of the discharge of dredged or fill material associated with the construction and routine operation of the 2020 Mine Plan. Such streamflow alterations would adversely affect approximately 29 miles (46.7 km) of anadromous fish streams downstream of the mine site due to greater than 20 percent changes in average monthly streamflow.[7] These streamflow alterations would result in major changes in ecosystem structure and function and would reduce both the extent and quality of anadromous fish habitat downstream of the mine. As recognized in the FEIS, all instances of complete loss of aquatic habitat and most impairment to fish habitat function would be permanent and "no other wild salmon fishery in the world exists in conjunction with an active mine of this size" (USACE 2020a: Page 4.6-9).

Although Alaska has many streams and wetlands that support salmon, individual streams, stream reaches, wetlands, lakes, and ponds play a critical role in supporting individual salmon populations and protecting the genetic diversity of Bristol Bay's wild salmon populations. The diverse array of watershed features across the region creates and sustains a diversity of aquatic habitats that support multiple populations of salmon with asynchronous run timings and habitat use patterns (i.e., biocomplexity, after Hilborn et al. 2003). These population differences are reflected in salmon genetic diversity and adaptation to local conditions within Bristol Bay's component watersheds (e.g., Quinn et al. 2012) and provide stability to the overall system (Schindler et al. 2010). Impacts of the 2020 Mine Plan are concentrated in the SFK and NFK watersheds, which are a part of the Nushagak River watershed. Recent analysis specific to the Nushagak River watershed underscores the important role that the streams, wetlands, lakes, and ponds across the entire Nushagak River watershed, including those that would be adversely affected by the 2020 Mine Plan, play in stabilizing the Nushagak River's productive Sockeye and Chinook salmon fisheries (Brennan et al. 2019). Similarly, both the Koktuli River (the SFK and NFK are tributaries to the Koktuli River) and UTC have been documented to support genetically distinct populations of Sockeye Salmon (Dann et al. 2012, Shedd et al. 2016, Dann et al. 2018). Loss of salmon habitats and associated salmon diversity in the SFK, NFK, and UTC watersheds would erode both the habitat complexity and biocomplexity that help buffer these populations from sudden and extreme changes in abundance, and ultimately maintain their productivity.

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[7] Streamflow alterations would vary seasonally. Streamflow reductions exceeding 20 percent of average monthly streamflow would occur in at least one month per year in at least 13.1 miles (21.4 km) of anadromous fish streams downstream of the mine site, and operation of the 2020 Mine Plan would increase streamflow by more than 20 percent of baseline average monthly streamflow in at least 25.7 miles (41.3 km) of downstream anadromous fish streams due to WTP discharges.

In addition to supporting genetically distinct salmon populations, the streams and wetlands draining the Pebble deposit area provide key habitat for numerous other fish species and supply water, invertebrates, organic matter, and other resources to downstream waters (Meyer et al. 2007, Colvin et al. 2019, Koenig et al. 2019). This is particularly true in dendritic stream networks like the SFK, NFK, and UTC systems, which have a high density of headwater streams. As a result, headwater streams and wetlands play a vital role in maintaining diverse, abundant anadromous fish populations—both by providing important fish habitat and supplying the energy and other resources needed to support anadromous fishes in connected downstream habitats.

EPA has determined the discharge of dredged or fill material for the construction and routine operation of the 2020 Mine Plan will have unacceptable adverse effects on anadromous fishery areas in the SFK and NFK watersheds. In this regard, EPA makes independent unacceptability findings, each of which is based on one or more factors, including the large amount of permanent loss of anadromous fish habitat (including spawning and breeding areas); the particular importance of the permanently lost habitat for juvenile Coho and Chinook salmon; the degradation of and thus damage to additional downstream spawning and rearing habitat for Coho, Chinook, and Sockeye salmon due to the loss of ecological subsidies provided by eliminated streams, wetlands, and other waters; and the resulting erosion of and thus damage to habitat complexity and biocomplexity within the SFK and NFK watersheds, both of which are key to the abundance and stability of salmon populations within these watersheds. EPA has also determined that discharges of dredged or fill material associated with developing the Pebble deposit anywhere in the mine site area (Figure ES-5) within the SFK and NFK watersheds that would result in the same or greater levels of loss or streamflow changes as the 2020 Mine Plan also will have unacceptable adverse effects on anadromous fishery areas in these watersheds, because such discharges would involve the same aquatic resources characterized as part of the evaluation of the 2020 Mine Plan. These conclusions support the prohibition described in Section 5.1 of this final determination.

Further, EPA has determined the discharge of dredged or fill material for the construction and routine operation of a mine at the Pebble deposit anywhere in the SFK, NFK, and UTC watersheds will have unacceptable adverse effects on anadromous fishery areas if the effects of such discharges are similar or greater in nature and magnitude to the adverse effects of the 2020 Mine Plan. In this regard, EPA makes independent unacceptability findings, each of which is based on one or more factors, including the pristine condition and ecological importance of anadromous habitat throughout the SFK, NFK, and UTC watersheds; how aquatic habitats across these three watersheds function similarly to support productive anadromous fishery areas; the large amount of permanent loss of anadromous fish habitat; the degradation of and thus damage to additional downstream spawning and rearing habitat for Coho, Chinook, and Sockeye salmon due to the loss of ecological subsidies provided by the eliminated streams, wetlands, and other waters; and the resulting erosion of and thus damage to habitat complexity and biocomplexity within the SFK, NFK, and UTC watersheds, both of which are key to the abundance and stability of salmon populations within these watersheds. This conclusion supports the restriction described in Section 5.2 of this final determination.

Overview of Prohibition and Restriction in the Final Determination

This final determination includes two parts: a prohibition and a restriction, which are described in more detail in Sections 5.1 and 5.2, respectively.

Prohibition

The EPA Assistant Administrator for Water has determined that the discharges of dredged or fill material for the construction and routine operation of the mine identified in the 2020 Mine Plan (PLP 2020b) at the Pebble deposit will have unacceptable adverse effects on anadromous fishery areas in the SFK and NFK watersheds. Based on information in PLP's CWA Section 404 permit application, the FEIS, and the ROD, such discharges would result in the following aquatic resource losses and streamflow changes:

- The loss of approximately 8.5 miles (13.7 km) of documented anadromous fish streams (Section 4.2.1).
- The loss of approximately 91 miles (147 km) of additional streams that support anadromous fish streams (Section 4.2.2).
- The loss of approximately 2,108 acres (8.5 km^2) of wetlands and other waters that support anadromous fish streams (Section 4.2.3).
- Adverse impacts on approximately 29 additional miles (46.7 km) of anadromous fish streams resulting from greater than 20 percent changes in average monthly streamflow (Section 4.2.4).

EPA has also determined that discharges of dredged or fill material for the construction and routine operation of a mine to develop the Pebble deposit anywhere in the mine site area within the SFK and NFK watersheds that would result in the same or greater levels of loss or streamflow changes as the 2020 Mine Plan also will have unacceptable adverse effects on anadromous fishery areas in these watersheds, because such discharges would involve the same aquatic resources characterized as part of the evaluation of the 2020 Mine Plan.

Sections 4.2.1 through 4.2.4 describe the basis for EPA's determination that each of the above losses and changes to streamflow independently will have unacceptable adverse effects on anadromous fishery areas (including spawning and breeding areas).

Accordingly, the Assistant Administrator for Water prohibits the specification of waters of the United States within the Defined Area for Prohibition (Figures ES-6, ES-7, and ES-8) as disposal sites for the discharge of dredged or fill material for the construction and routine operation of the 2020 Mine Plan. For purposes of the prohibition, the "2020 Mine Plan" is (1) the mine plan described in PLP's June 8, 2020 CWA Section 404 permit application (PLP 2020b) and the FEIS (USACE 2020a); and (2) future proposals to construct and operate a mine to develop the Pebble deposit with discharges of dredged or fill material in the Defined Area for Prohibition that would result in the same or greater levels of loss or

streamflow changes as the mine plan described in PLP's June 8, 2020 CWA Section 404 permit application.[8] Because each of the losses or streamflow changes described in Sections 4.2.1 through 4.2.4 independently will have unacceptable adverse effects on anadromous fishery areas, future proposals to construct and operate a mine to develop the Pebble deposit that result in any one of these losses or streamflow changes will be subject to the prohibition.

Restriction

The Assistant Administrator for Water has determined that discharges of dredged or fill material associated with future proposals to construct and operate a mine to develop the Pebble deposit will have unacceptable adverse effects on anadromous fishery areas (including spawning and breeding areas) anywhere in the SFK, NFK, and UTC watersheds if the adverse effects of such discharges are similar or greater in nature[9] and magnitude[10] to the adverse effects of the 2020 Mine Plan described in Sections 4.2.1 through 4.2.4 of this final determination.

Accordingly, the Assistant Administrator for Water restricts the use of waters of the United States within the Defined Area for Restriction (Figures ES-7 and ES-8) for specification as disposal sites for the discharge of dredged or fill material associated with future proposals to construct and operate a mine to develop the Pebble deposit that would either individually or cumulatively result in adverse effects similar or greater in nature and magnitude to those described in Sections 4.2.1 through 4.2.4 of this final determination. Because each of the losses or streamflow changes described in Sections 4.2.1 through 4.2.4 independently will have unacceptable adverse effects on anadromous fishery areas, proposals to discharge dredged or fill material that result in any one of these losses or streamflow changes will be subject to the restriction. To the extent that future discharges are subject to the prohibition, the restriction will not apply.

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[8] By clarifying that the "2020 Mine Plan" includes, for the purposes of the prohibition, future proposals to construct and operate a mine to develop the Pebble deposit with discharges of dredged or fill material in the Defined Area for Prohibition that would result in the same or greater levels of loss or streamflow changes as the mine plan described in PLP's June 8, 2020 CWA Section 404 permit application, EPA ensures that future applicants cannot circumvent the prohibition by proposing small changes in the location of discharges within the mine site that would not result in any change to the levels of aquatic resource loss or streamflow change, or that would result in greater levels of aquatic resource loss or streamflow change. In doing so, EPA gives full effect to the purpose of the prohibition to prevent adverse effects at the mine site that EPA has already determined are unacceptable.

[9] *Nature* means type or main characteristic (see Cambridge Dictionary available at: https://dictionary.cambridge.org/us/dictionary/english/nature).

[10] *Magnitude* refers to size or importance (see Cambridge Dictionary available at: https://dictionary.cambridge.org/us/dictionary/english/magnitude).

Figure ES-6. The Defined Area for Prohibition at the 2020 Mine Plan mine site. Figure based on information from PLP (2020b), USGS (2021a), and USGS (2021b).

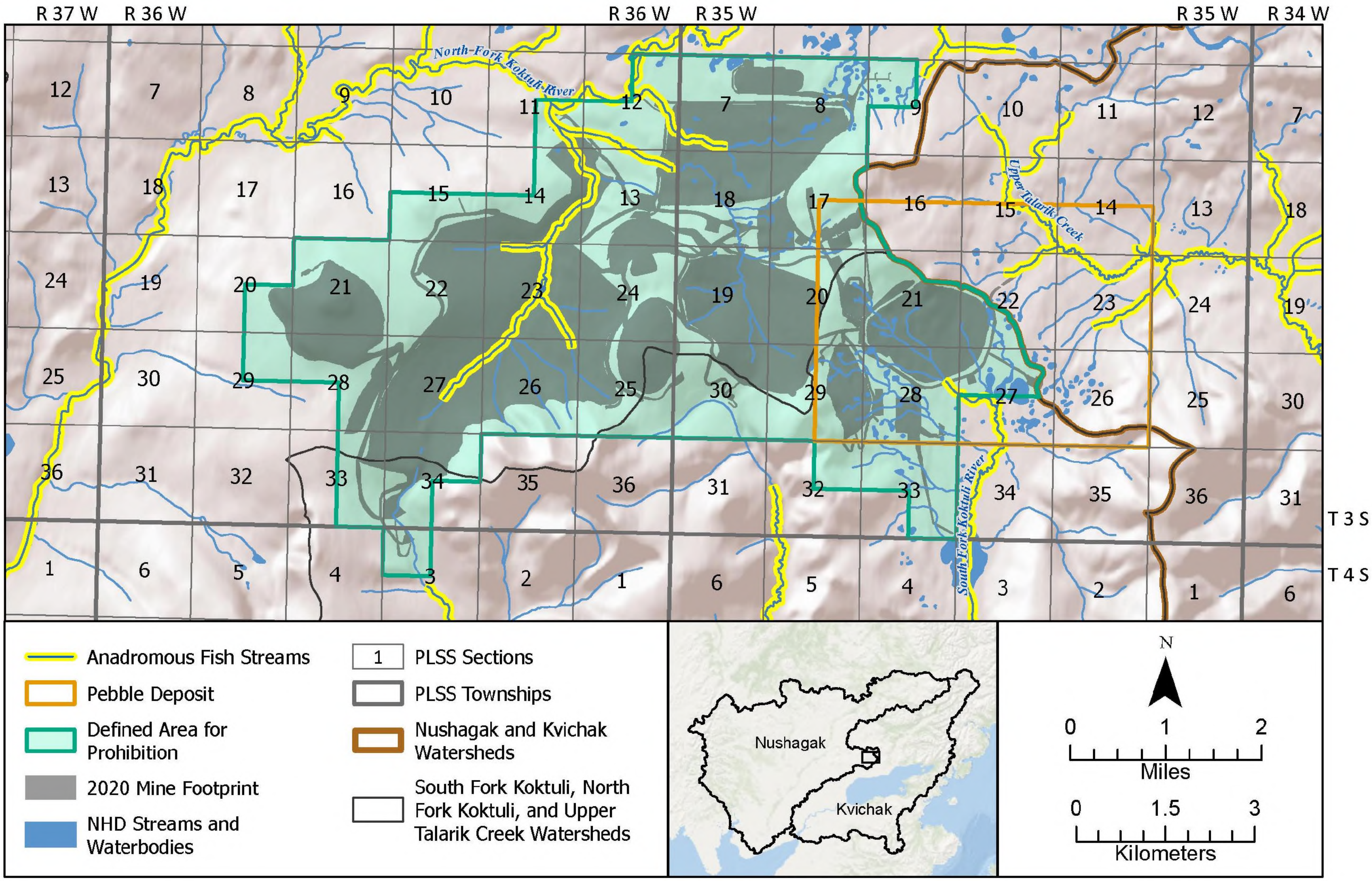


Figure ES-7. The Defined Area for Restriction and the Defined Area for Prohibition overlain on wetlands from the National Wetlands Inventory (USFWS 2021).

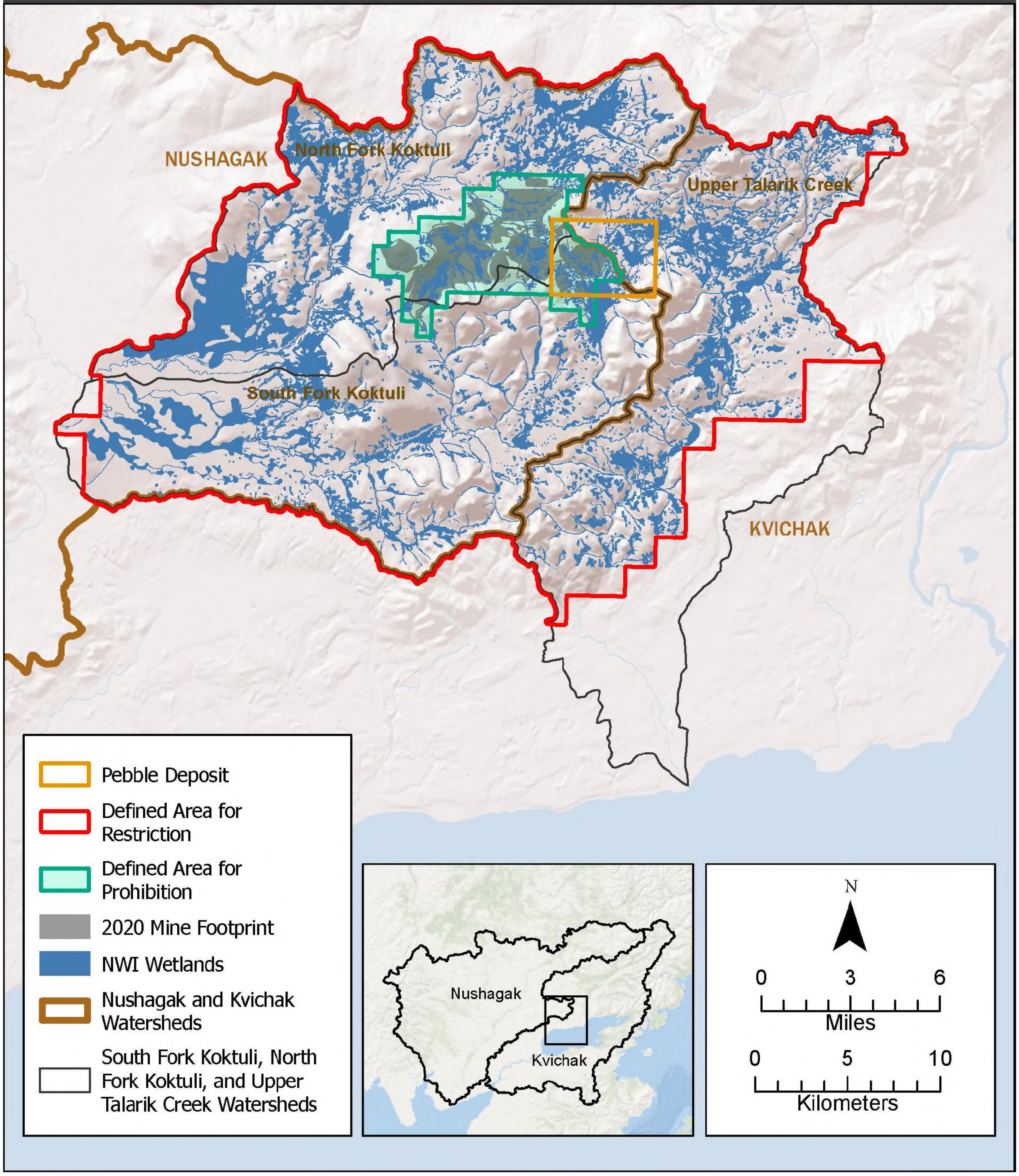
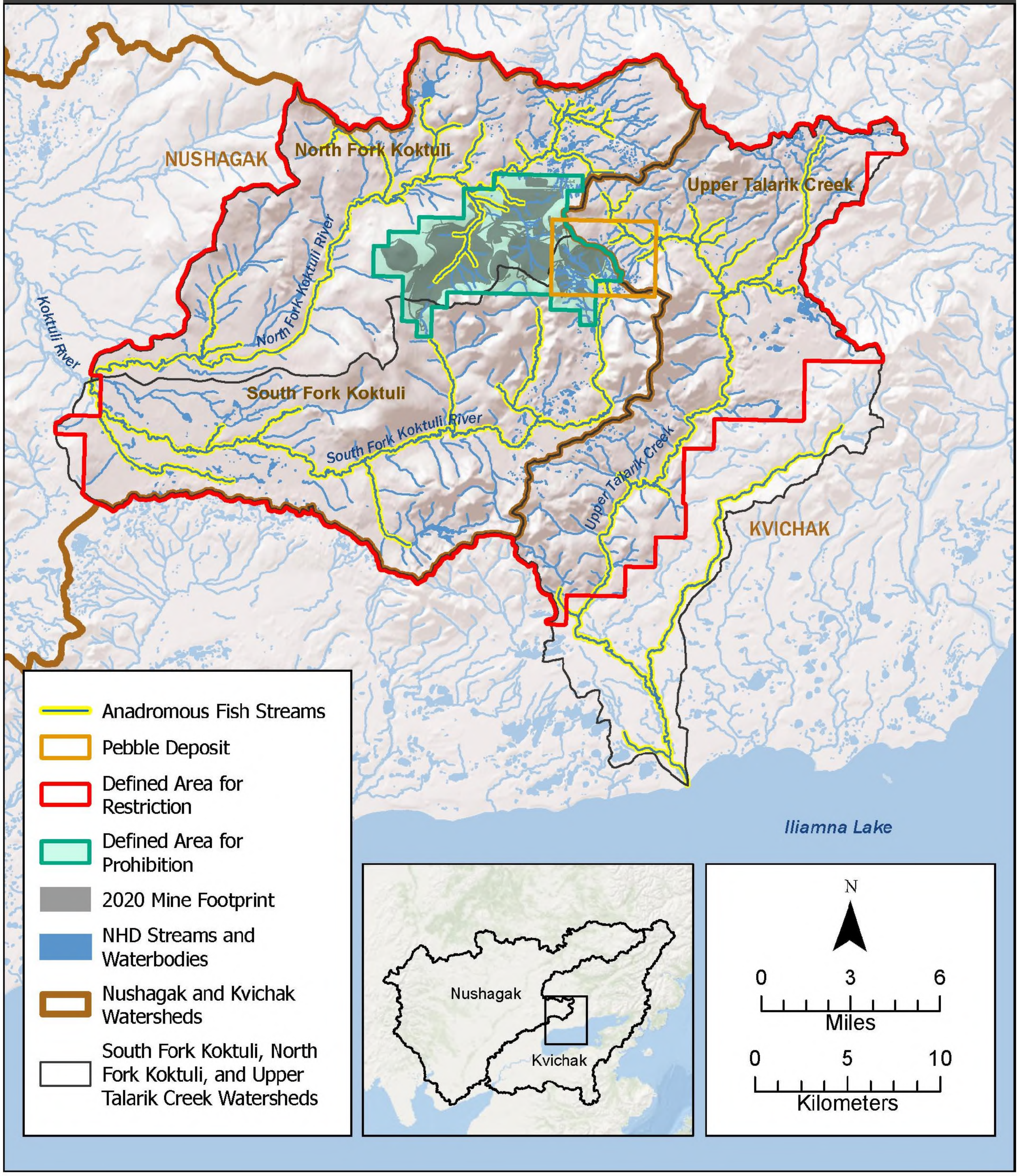


Figure ES-8. The Defined Area for Restriction and the Defined Area for Prohibition overlain on streams and waterbodies from the National Hydrography Dataset (USGS 2021b).



Evaluation of Portions of the CWA Section 404(b)(1) Guidelines

EPA's CWA Section 404(c) regulations provide that consideration should be given to the "relevant portions of the Section 404(b)(1) Guidelines" in evaluating the "unacceptability" of effects (40 CFR 231.2(e)). EPA's consideration of the relevant portions of the CWA Section 404(b)(1) Guidelines further confirm EPA's unacceptable adverse effects determinations.

Specifically, EPA has determined that direct and secondary effects of the discharge of dredged or fill material for the construction and routine operation of the 2020 Mine Plan would result in significant degradation under the CWA Section 404(b)(1) Guidelines. Additionally, EPA has determined that direct and secondary effects of the discharge of dredged or fill material associated with future proposals to construct and operate a mine at the Pebble deposit that would result in adverse effects that are the same, similar or greater than the adverse effects of the 2020 Mine Plan would also result in significant degradation under the CWA Section 404(b)(1) Guidelines. These findings are based on the significantly adverse effects of the discharge of dredged or fill material on special aquatic sites, life stages of anadromous fishes, anadromous fish habitat, and aquatic ecosystem diversity, productivity, and stability under the CWA Section 404(b)(1) Guidelines.

EPA evaluated PLP's two compensatory mitigation plans and neither plan adequately mitigates adverse effects described in this final determination to an acceptable level. For informational purposes, EPA also evaluated additional potential compensation measures proposed by PLP and others over the past decade (see Appendix C of this final determination). Available information demonstrates that known compensation measures are unlikely to adequately mitigate effects described in this final determination to an acceptable level. Information regarding evaluation of the CWA Section 404(b)(1) Guidelines can be found in Section 4.3 of this final determination.

Information about Other Adverse Effects of Concern on Aquatic Resources

While not a basis for EPA's final determination, EPA has identified additional potential adverse effects of concern on aquatic resources within the SFK, NFK, and UTC watersheds from discharges of dredged or fill material associated with developing the Pebble deposit.[11] First, adverse effects could result from accidents and failures, such as a tailings dam failure. Uncertainty exists as to whether severe accidents or failures could be prevented over a management horizon of centuries (or in perpetuity), particularly in such a geographically remote area. If such events were to occur, they would have profound ecological ramifications. Second, there are potential adverse impacts associated with the ancillary project components beyond the mine site, such as along the transportation corridor and at the Diamond Point port. Third, there are potential adverse impacts associated with the reasonably foreseeable expansion of

[11] EPA provides an alternative basis for its determination that relies on a broader set of considerations in Section 4.4 of this final determination. To the extent statements in this final determination outside of Section 4.4 conflict with statements within Section 4.4, for purposes of the alternative basis for EPA's determination the text of Section 4.4 governs.

the 2020 Mine Plan evaluated in the FEIS. The FEIS finds that it is reasonably foreseeable that the mine proposed in the 2020 Mine Plan would expand in the future to mine approximately 8.6 billion tons of ore over 78 years. The FEIS estimates that the discharge of dredged or fill material for the construction and operation of this expanded mine would result in the total loss of approximately 430 miles (6921 km) of streams at the expanded mine site, representing approximately 43.5 miles (70 km) of anadromous fish streams and approximately 386 miles (621 km) of additional streams that support anadromous fish streams. Further, the FEIS estimates that discharges of dredged or fill material to construct and operate the expanded mine site would also result in the total loss of more than 10,800 acres (43.7 km^2) of wetlands and other waters that support anadromous fish streams. EPA has already determined that the adverse effects of the discharges evaluated in this final determination are unacceptable and the additional losses that would result from the Expanded Mine Scenario would represent extraordinary and unprecedented levels of anadromous fish habitat loss and degradation, dramatically expanding the scope and scale of unacceptable adverse effects in the SFK, NFK, and UTC watersheds. For example, significant additional anadromous fish habitat losses and degradation in the SFK, NFK, and UTC watersheds caused by future expansion of the mine would threaten genetically distinct Sockeye Salmon populations in both the Koktuli River and UTC.

See Section 6 of this final determination for a discussion of other concerns and considerations.

Authority and Justification for Undertaking a CWA Section 404(c) Review at this Time

Congress enacted CWA Section 404(c) to provide EPA the ultimate authority, if it chooses on a case-by-case basis, to prohibit, withdraw, deny, or restrict the use of any defined area for specification as a disposal site for the discharge of dredged or fill material into waters of the United States "whenever" the Agency makes the required determination under the statute (33 USC 1344(c); 40 CFR 231.1(a), (c); 44 FR 58076; *Mingo Logan Coal Co. v. EPA*, 714 F.3d 618, 612-13 (D.C. Cir. 2013)). EPA may exercise its CWA Section 404(c) authority "at any time," including before a permit application has been submitted, at any point during the permitting process, and after a permit has been issued (*Mingo Logan Coal Co.*, 714 F.3d at 613; 33 U.S.C. 1344(c); 40 CFR 231.1(a), (c); 44 FR 58076).

EPA has reviewed the available information, including the relevant portions of the USACE permitting record, and this information supports EPA's determinations that the discharges of dredged or fill material evaluated in this final determination will have unacceptable adverse effects on anadromous fishery areas within the SFK, NFK, and UTC watersheds.

By acting now, EPA makes clear its assessment of the effects of certain discharges of dredged or fill material associated with developing the Pebble deposit into certain waters of the United States within the SFK, NFK, and UTC watersheds in light of the significant loss of and damage to important anadromous fishery areas. The federal government, the State of Alaska, federally recognized tribal governments, PLP, and many other interested parties have devoted significant resources over many years of study, engagement, and review. Considering the extensive record, it is not efficient or effective

to engage in one or more additional multi-year NEPA and CWA Section 404 processes for future proposals to discharge dredged or fill material associated with developing the Pebble deposit into waters of the United States within the SFK, NFK, or UTC watersheds that will result in adverse effects that EPA has already determined are unacceptable. By acting now, based on an extensive and carefully considered record, EPA promotes regulatory certainty for all interested parties, including USACE and the regulated community; facilitates planning by proponents; and avoids unnecessary expenditure of additional resources by all interested parties (see 44 FR 58077). Ultimately, by acting now, EPA also facilitates "comprehensive rather than piecemeal protection" of important aquatic resources (see *id.*) by ensuring the protection of valuable anadromous fishery areas in the SFK, NFK, and UTC watersheds against unacceptable adverse effects from the discharges evaluated in this final determination.

Conclusion

Discharges of dredged or fill material to construct and operate the 2020 Mine Plan's proposed mine site alone would result in the permanent loss of approximately 8.5 miles (13.7 km) of anadromous fish streams, 91 miles (147 km) of additional streams that support anadromous fish streams, and approximately 2,108 acres (8.5 km^2) of wetlands and other waters in the SFK and NFK watersheds that support anadromous fish streams. These discharges would also result in streamflow alterations that would adversely affect approximately 29 miles (46.7 km) of additional anadromous fish streams downstream of the mine site due to greater than 20 percent changes in average monthly streamflow. The aquatic resources that would be lost or damaged play an important role in supporting salmon populations in the SFK, NFK, and UTC watersheds.

EPA has determined that the large-scale loss of and damage to headwater streams, wetlands, and other aquatic resources that support salmon populations in the SFK, NFK, and UTC watersheds from the discharge of dredged or fill material for the construction and routine operation of the 2020 Mine Plan will have unacceptable adverse effects on anadromous fishery areas in the SFK, NFK, and UTC watersheds.

To prevent these unacceptable adverse effects, this final determination prohibits the specification of certain waters of the United States in the SFK and NFK watersheds as disposal sites for the discharge of dredged or fill material for the construction and routine operation of the 2020 Mine Plan, including future proposals to construct and operate a mine to develop the Pebble deposit with discharges of dredged or fill material into waters of the United States that would result in the same or greater levels of aquatic resource loss or streamflow changes as the 2020 Mine Plan.

This final determination also restricts the use for specification of certain waters of the United States in the SFK, NFK, and UTC watersheds as disposal sites for the discharge of dredged or fill material associated with future proposals to construct and operate a mine to develop the Pebble deposit with discharges of dredged or fill material into waters of the United States that would result in adverse effects

similar or greater in nature and magnitude to the adverse effects of the 2020 Mine Plan (see Section 5 of this final determination).

Proposals to discharge dredged or fill material into waters of the United States associated with developing the Pebble deposit that are not subject to this determination remain subject to all statutory and regulatory authorities and requirements under CWA Section 404.

In light of the immense and unique economic, social, cultural, and ecological value of the aquatic resources in the region, including the fishery areas in the SFK, NFK, and UTC watersheds, and their susceptibility to damage, EPA will carefully evaluate all future proposals to discharge dredged or fill material in the region.

SECTION 1. INTRODUCTION

The Clean Water Act (CWA), 33 U.S. Code (U.S.C.) § 1251 et seq., prohibits the discharge of pollutants, including dredged or fill material, into waters of the United States (including wetlands) except in compliance with, among other provisions, Section 404 of the CWA, 33 U.S.C. § 1344, 33 U.S.C. § 1311. Section 404(a) of the CWA authorizes the Secretary of the Army (Secretary), acting through the Chief of Engineers (U.S. Army Corps of Engineers or USACE), to authorize the discharge of dredged or fill material at specified disposal sites. This authorization is conducted, in part, through the application of environmental guidelines developed by the U.S. Environmental Protection Agency (EPA), in conjunction with the Secretary, under Section 404(b) of the CWA. Section 404(c) of the CWA authorizes EPA to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site and to restrict or deny the use of any defined area for specification (including the withdrawal of specification) as a disposal site whenever it determines, after notice and opportunity for public hearing, that the discharge of such materials into such area will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.

The procedures for implementation of CWA Section 404(c) are set forth in Title 40 of the Code of Federal Regulations (CFR) Part 231 and establish a four-step CWA Section 404(c) review process.

- **Step 1: Initial Notification.** If the EPA Regional Administrator has reason to believe, after evaluating the information available to him, that an unacceptable adverse effect could result from the specification or use of a defined area for the disposal of dredged or fill material on one or more of the statutorily listed resources, the Regional Administrator may initiate the CWA Section 404(c) review process by notifying USACE,[12] the owner(s) of record of the site, and the permit applicant (if any), that he intends to issue a public notice of a proposed determination to prohibit or withdraw the specification, or to deny, restrict, or withdraw the use for specification, whichever the case may be, of any defined area as a disposal site.
- **Step 2: Proposed Determination.** If, within 15 days of EPA's initial notification, USACE, the owner(s) of record of the site, and the applicant (if any) have not demonstrated to the satisfaction of the Regional Administrator that no unacceptable adverse effects will occur, or USACE has not notified the Regional Administrator of its intent to take corrective action to prevent an unacceptable adverse effect to his satisfaction, the Regional Administrator shall publish notice of a proposed determination in the *Federal Register*, soliciting public comment on the proposed determination and,

[12] The state would be notified here if the site is covered by an EPA-approved state program (CWA Section 404(g)) to issue permits for discharges of dredged or fill material at specified sites in waters of the United States (40 CFR 231.3(a)(1)).

where the Regional Administrator finds a significant degree of public interest in a proposed determination or that it would be otherwise in the public interest to hold a hearing, offering an opportunity for public hearing.

- **Step 3: Recommended Determination**. Following a public hearing, if one is held, and the close of the comment period, the Regional Administrator must decide whether to withdraw the proposed determination or prepare a recommended determination. If the Regional Administrator prepares a recommended determination, the Regional Administrator must forward the recommended determination and the administrative record to the Assistant Administrator for Water at EPA Headquarters.[13] If the Regional Administrator decides to withdraw the proposed determination, he must notify the Assistant Administrator for Water, who may review the withdrawal at her discretion.[14]
- **Step 4: Final Determination**. If the Regional Administrator prepares and forwards a recommended determination to the Assistant Administrator for Water, the Assistant Administrator for Water will review the recommended determination of the Regional Administrator and the information in the administrative record. The Assistant Administrator for Water will also consult with USACE, the owner(s) of record of the site, and the applicant (if any). Following consultation and consideration of the record, the Assistant Administrator for Water will make the final determination affirming, modifying, or rescinding the recommended determination.

EPA has developed this final determination to prohibit the specification of and restrict the use for specification of certain waters in the Bristol Bay watershed as a disposal site for the discharge of dredged or fill material associated with developing the Pebble deposit, a large ore body in southwest Alaska. The EPA Assistant Administrator for Water is exercising her authority under Section 404(c) of the CWA and its implementing regulations at 40 CFR Part 231 because she has determined that certain discharges of dredged or fill material associated with developing the Pebble deposit will have

[13] In 1984, the EPA Administrator delegated the authority to make final determinations under CWA Section 404(c) to EPA's national CWA Section 404 program manager, who is the Assistant Administrator for Water. That delegation remains in effect. With regard to EPA's CWA Section 404(c) action for the Pebble deposit area, on March 22, 2019, former Administrator Wheeler delegated to the General Counsel the authority to perform all functions and responsibilities retained by the Administrator or previously delegated to the Assistant Administrator for Water related to that action due to the recusals of former Administrator Wheeler and former Assistant Administrator for Water David Ross from participation in matters related to Pebble Mine, which is associated with the Pebble deposit area. The Administrator rescinded the March 22, 2019 one-time delegation on May 17, 2022, because neither the current Administrator nor the current Assistant Administrator for Water have such recusals in place. As a result, the 1984 delegation controls and all functions and responsibilities retained by the Administrator related to the Pebble deposit are delegated to the Assistant Administrator for Water.

[14] If within 10 days of the Regional Administrator notifying the Assistant Administrator for Water of his decision to withdraw the proposed determination, the Assistant Administrator for Water does not notify the Regional Administrator of her intent to review such withdrawal, the Regional Administrator shall give public notice of the withdrawal of the proposed determination. If the Assistant Administrator for Water does decide to review, the Regional Administrator or his designee shall forward the administrative record to the Assistant Administrator for Water for a final determination.

unacceptable adverse effects on anadromous[15] fishery areas in the South Fork Koktuli River (SFK), North Fork Koktuli River (NFK), and Upper Talarik Creek (UTC) watersheds which are located within the Bristol Bay watershed.

This final determination represents Step 4 in the process described previously. In this final determination, the EPA Assistant Administrator for Water (1) prohibits the specification of a defined area as a disposal site, and (2) restricts the use of a defined area for specification as a disposal site because she has determined that certain discharges of dredged or fill material associated with developing the Pebble deposit into these defined areas will have unacceptable adverse effects on anadromous fishery areas.

This final determination is organized as follows.

- Section 2 provides background information on the Pebble deposit, a large, low-grade, porphyry copper deposit that underlies portions of the SFK, NFK, and UTC watersheds; a description of the mine plan developed by the Pebble Limited Partnership (PLP) in support of its CWA Section 404 permit application (the 2020 Mine Plan); a timeline of key events related to the Pebble deposit; and a summary of EPA's actions taken related to CWA Section 404(c) in this case.
- Section 3 provides an overview of the streams, wetlands, and other aquatic resources of the Bristol Bay watershed and discusses their role in supporting important subsistence, commercial, and recreational fisheries. It also describes the streams, wetlands, and other aquatic resources of the SFK, NFK, and UTC watersheds within the Bristol Bay watershed and discusses how they are integral to maintaining the productivity, integrity, and sustainability of both salmon and non-salmon fishery resources. This section also describes how salmon population diversity and dynamics interact to create a portfolio of biological assets resulting in a sustainable fishery.
- Section 4 describes the basis for EPA's determination that the direct and secondary effects of the discharges of dredged or fill material evaluated in this final determination into certain streams, wetlands, and other aquatic resources of the SFK, NFK, and UTC watersheds will have unacceptable adverse effects on anadromous fishery areas in those watersheds. These unacceptable adverse effects include the permanent loss of and damage to streams, wetlands, and other aquatic resources that are important for supporting anadromous fish habitat.
- Section 5 presents the prohibition and the restriction, which are designed to prevent unacceptable adverse effects on anadromous fishery areas in the SFK, NFK, and UTC watersheds that will result from the discharges of dredged or fill material evaluated in this final determination.
- Section 6 identifies other concerns and information that, while not the basis for EPA's final determination, are related to discharges of dredged or fill material evaluated in this final

[15] Anadromous fishes are those that hatch in freshwater habitats, migrate to sea for a period of relatively rapid growth, and then return to freshwater habitats to spawn. For the purposes of this final determination, "anadromous fishes" refers only to Coho or Silver salmon (*Oncorhynchus kisutch*), Chinook or King salmon (*O. tshawytscha*), Sockeye or Red salmon (*O. nerka*), Chum or Dog salmon (*O. keta*), and Pink or Humpback salmon (*O. gorbuscha*).

determination. Such concerns include potential impacts on subsistence resources, environmental justice issues, traditional ecological knowledge, as well as potential spills and failures associated with mine infrastructure at the Pebble deposit. Section 6 also includes other concerns and considerations related to the potential for the discharges of dredged or fill material evaluated in this final determination to result in adverse effects on wildlife, recreation, or public water supplies.

- Section 7 provides the conclusion for the final determination.
- Section 8 lists references cited in the final determination.

SECTION 2. PROJECT DESCRIPTION AND BACKGROUND

2.1 Project Description

2.1.1 Overview of the Pebble Deposit

Several known mineral deposits are located in the Nushagak and Kvichak River watersheds (EPA 2014, USACE 2020a, Kalanchey et al. 2021). The deposit types occurring or likely to occur in the region include porphyry copper, intrusion-related gold, and copper and iron skarn. The potential for mining development within these watersheds appears to be greatest for the Pebble deposit because significant exploration activity has occurred at this deposit for many years and a significant amount of information about this deposit is available.

The Pebble deposit is a large, low-grade deposit containing copper-, gold-, and molybdenum-bearing minerals that underlies portions of the SFK, NFK, and UTC watersheds. The SFK and NFK watersheds are part of the Nushagak River watershed, and the UTC watershed is part of the Kvichak River watershed (Figure ES-2). Extraction at the Pebble deposit would involve the creation of a large open pit and the production of large amounts of waste rock and mine tailings (USACE 2020a).

The Pebble deposit extends over an area of at least 1.9 by 2.8 miles and consists of two contiguous segments, Pebble West and Pebble East (Ghaffari et al. 2011). The approximate center of the deposit is about 9.2 miles north–northeast of Sharp Mountain and 18.7 miles northwest of Iliamna. It covers portions of sections 14 to 16, 20 to 23, and 26 to 29, T. 3 S., R. 35 W., Seward Meridian.[16] The full extent of the Pebble deposit is not yet defined, but Kalanchey et al. (2021) indicate that the Pebble mineral resource may approach 11 billion tons of ore.

PLP holds the largest mine claim block in the Nushagak and Kvichak River watersheds. In 2017, PLP submitted a CWA Section 404 permit application to USACE to develop a mine at the Pebble deposit, which triggered USACE's development of a Final Environmental Impact Statement (FEIS) pursuant to the National Environmental Policy Act (NEPA). As discussed in Section 2.2.1, PLP revised its application during the NEPA and CWA Section 404 review processes, and the final revision (the 2020 Mine Plan) was submitted to USACE in June 2020.

[16] Mine claims may be located by what is known as aliquot part legal description, which is meridian, township, range, section, quarter section, and if applicable quarter-quarter section. These claims are known as MTRSC locations, and they are generally located using global positioning system (GPS) latitude and longitude coordinates. A quarter section location is typically about 160 acres in size, and a quarter-quarter section location is typically 40 acres in size (ADNR 2022a).

2.1.2 Overview of the 2020 Mine Plan

This section describes the 2020 Mine Plan, as presented in PLP's June 8, 2020 CWA Section 404 permit application to USACE (PLP 2020b).[17] The 2020 Mine Plan is evaluated in USACE's FEIS and is identified in the FEIS as Alternative 3 – North Road Only Alternative, Concentrate Pipeline and Return Pipeline Variant.

In the 2020 Mine Plan, PLP proposes to develop the Pebble copper-gold-molybdenum porphyry deposit as a surface mine. The closest communities are the villages of Iliamna, Newhalen, and Nondalton, each of which is approximately 17 miles from the deposit (USACE 2020b). The 2020 Mine Plan would progress through four distinct phases: construction, operations (also referred to as production), closure, and post-closure. The construction period would last approximately 4 years, followed by 20 years of operation. Closure, including physical reclamation of the mine site, is projected to take approximately 20 years. Post-closure activities, including long-term water management and monitoring, is expected to last for centuries (USACE 2020a).

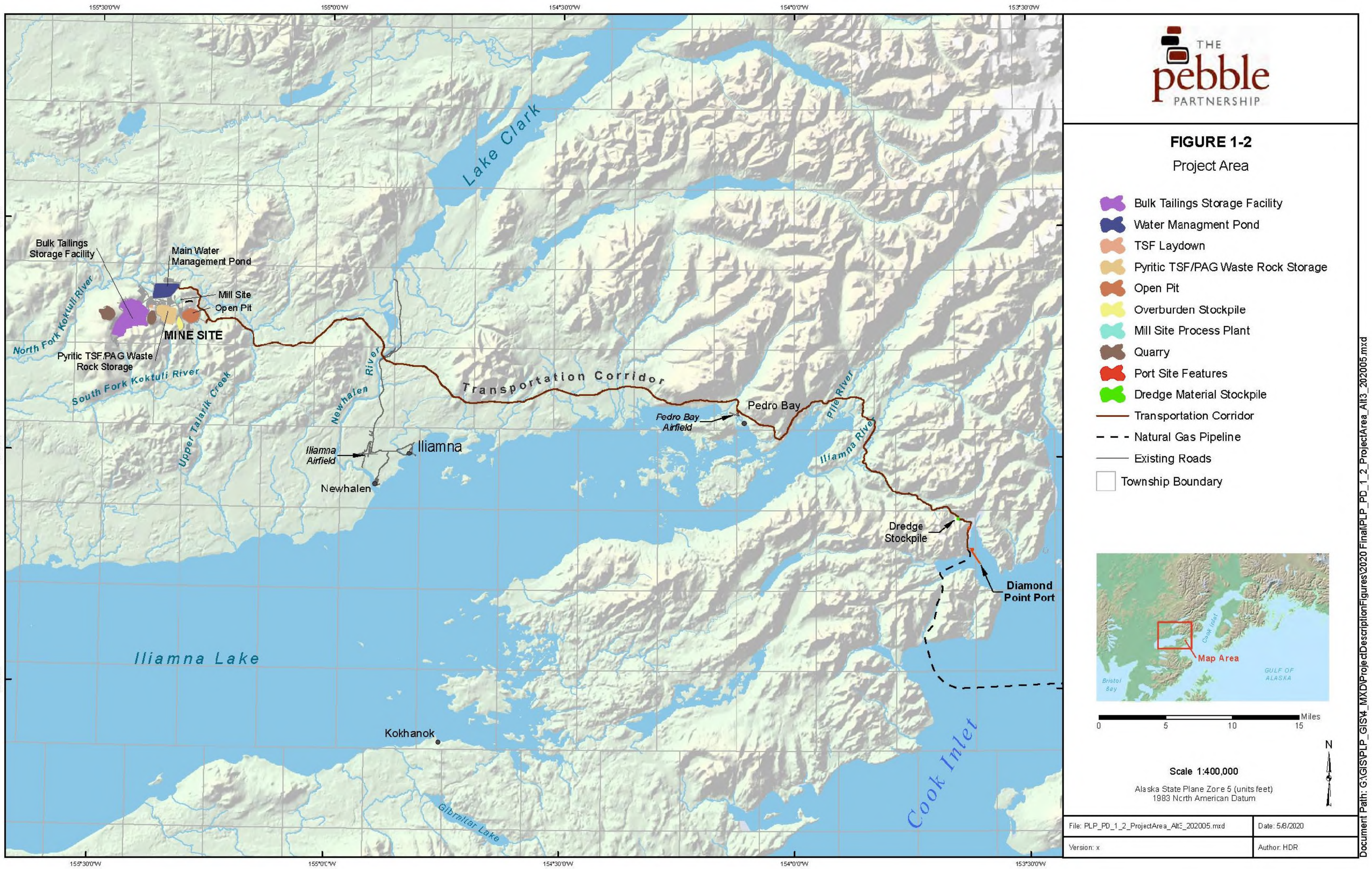
The project consists of four primary elements: the mine site; the Diamond Point port; the transportation corridor, including concentrate and water return pipelines; and the natural gas pipeline and fiber optic cable (Figure 2-1). Between 2018 and 2020, EPA reviewed all four of the primary elements of the 2020 Mine Plan as part of its review of PLP's CWA Section 404 permit application (EPA 2019a), the Draft Environmental Impact Statement (DEIS) (EPA 2019b) and other documents related to the NEPA review, and during the 12-week coordination process with USACE in spring 2020 to evaluate PLP's proposed project for compliance with the CWA Section 404(b)(1) Guidelines. In its Record of Decision (ROD) denying PLP's CWA Section 404 permit application, USACE specifically finds that the discharges of dredged or fill material at the mine site associated with the 2020 Mine Plan would cause significant degradation to the aquatic ecosystem pursuant to the Guidelines (USACE 2020b). Similarly, EPA focused its evaluation during the CWA Section 404(c) process on the adverse effects of the discharges of dredged or fill material proposed at the mine site because, based on the review of the available information, the adverse effects on anadromous fishery areas associated with mine site discharges would be the most significant of the four primary elements of the 2020 Mine Plan.

2.1.2.1 Mine Site

According to USACE, the 2020 Mine Plan is proposed to be a conventional drill, blast, truck, and shovel operation with a mining rate of up to 73 million tons of ore per year. Approximately 1,300 million tons of mineralized rock and 150 million tons of waste rock and overburden would be mined over the project's life. The mineralized material would be crushed and sent to a coarse ore stockpile to feed the process plant. The process plant would include grinding and flotation steps, with a processing rate of up to 66 million tons per year, to produce on average 613,000 tons of copper-gold concentrate and 15,000 tons of molybdenum concentrate annually (USACE 2020b).

[17] Pebble Project Department of the Army Application for Permit POA-2017-00271.

Figure 2-1. Project area map. Figure 1-2 from PLP's June 8, 2020 Clean Water Act Section 404 permit application (PLP 2020b).



The fully developed mine site would include an open pit, bulk tailings storage facility (TSF), pyritic TSF, a 270-megawatt power plant, water management ponds (WMPs), water treatment plants (WTPs), and milling/processing facilities, as well as supporting infrastructure. Non-potentially acid generating and non-metal leaching waste rock would be used in the construction of infrastructure needed to support the mine. In addition to waste rock, three quarries (material sites) would be needed (USACE 2020b) (Figure ES-4).

Bulk tailings would be placed in the bulk TSF, while pyritic tailings would be placed in the lined pyritic TSF. Potentially acid generating (PAG) and metal leaching waste rock would be stored in the lined pyritic TSF until closure, when it would be back-hauled into the open pit. The bulk TSF would have two embankments: the main embankment, constructed using the centerline construction method; and the south embankment, constructed using the downstream construction method to facilitate lining of the upstream face. The pyritic TSF would be fully lined and would have three embankments constructed using the downstream method (USACE 2020b).

Soils and other overburden would be stored in stockpile areas at various locations throughout the site. Stockpiled soils and other overburden would be used for reclamation during mine closure. The proposed mine site is currently undeveloped and is not served by any transportation or utility infrastructure (USACE 2020b).

According to USACE, PLP would manage water flows through the mine area, while providing a water supply for operations. PLP would capture runoff water contacting the facilities at the mine site and water pumped from the open pit, then either reuse the water in the milling process or treat the water before releasing it to surface waters (USACE 2020b).

The open-pit area would be dewatered through groundwater withdrawal from approximately 30 groundwater wells installed around the open-pit perimeter. As the pit is deepened, dewatering would continue via in-pit ditches, in-pit wells, and/or perimeter wells. The water level in the open pit would continue to be managed via pumping of groundwater wells and transfer to the open-pit WMP (USACE 2020b).

As described by USACE, mine facilities would be closed at the end of operations and reclaimed. Reclamation and closure of the project would fall under the jurisdiction of Alaska Department of Natural Resources (ADNR) Division of Mining, Land, and Water and the Alaska Department of Environmental Conservation (ADEC). The Alaska Reclamation Act (Alaska Statute 27.19) is administered by ADNR. It applies to state, federal, municipal, and private land, as well as water subject to mining operations. PLP has prepared a Reclamation and Closure Plan providing guidelines for implementing stabilization and reclamation procedures for various facilities associated with the project (USACE 2020a: Appendix M4.0). USACE indicates that revisions to PLP's Reclamation and Closure Plan may be necessary to address changes during preliminary and detailed design work and state permitting (USACE 2020b). ADNR would be responsible for approving PLP's Reclamation and Closure Plan.

2.1.2.2 Evaluation of Location Options for a Mine Site at the Pebble Deposit

As part of considering alternatives in the Environmental Impact Statement (EIS) and CWA Section 404 processes, USACE evaluated multiple locations throughout the SFK, NFK, and UTC watersheds for siting various components associated with a mine site at the Pebble deposit (USACE 2020a: Section 2 and Appendix B). Siting criteria used to select options varied based on the mine component under consideration but included factors related to potential site capacity, total footprint and catchment area, distance from other mine site components, and ground/substrate conditions. Screening criteria, including overall project purpose, practicability, and environmental impacts, were applied to the range of options and locations identified during the EIS process to narrow the range of alternatives considered in the NEPA and CWA Section 404 analyses.

For example, 26 land options were initially evaluated as potential TSF locations and "detailed information" was provided for each (USACE 2020a: Page B-83). Twenty-three of these options were located at sites within the SFK, NFK, and UTC watersheds (Figure 2-2). The 26 options were compared to the TSF locations put forth in PLP's permit application, and all were rejected. Seven of the options were determined not to be practicable (i.e., not feasible due to inappropriate substrate conditions or inadequate capacity). The remaining options "would all increase the wetlands and stream miles filled when compared to the proposed project" and "would pose risks similar to the proposed project in the event of a tailings dam failure" (USACE 2020a: Page B-84). Similarly, seven alternate locations for the main WMP were evaluated and detailed information was provided for each. All seven options were located within the SFK, NFK, and UTC watersheds (USACE 2020a: Appendix B) (Figure 2-3), and all were rejected because detailed evaluation found them to be "not reasonable or not feasible" (USACE 2020a: Page B-91).

Figure 2-2. Optional locations for siting the Bulk Tailing Storage Facility evaluated within the FEIS. Figure 1.0 from PLP (2018d: RFI 069).

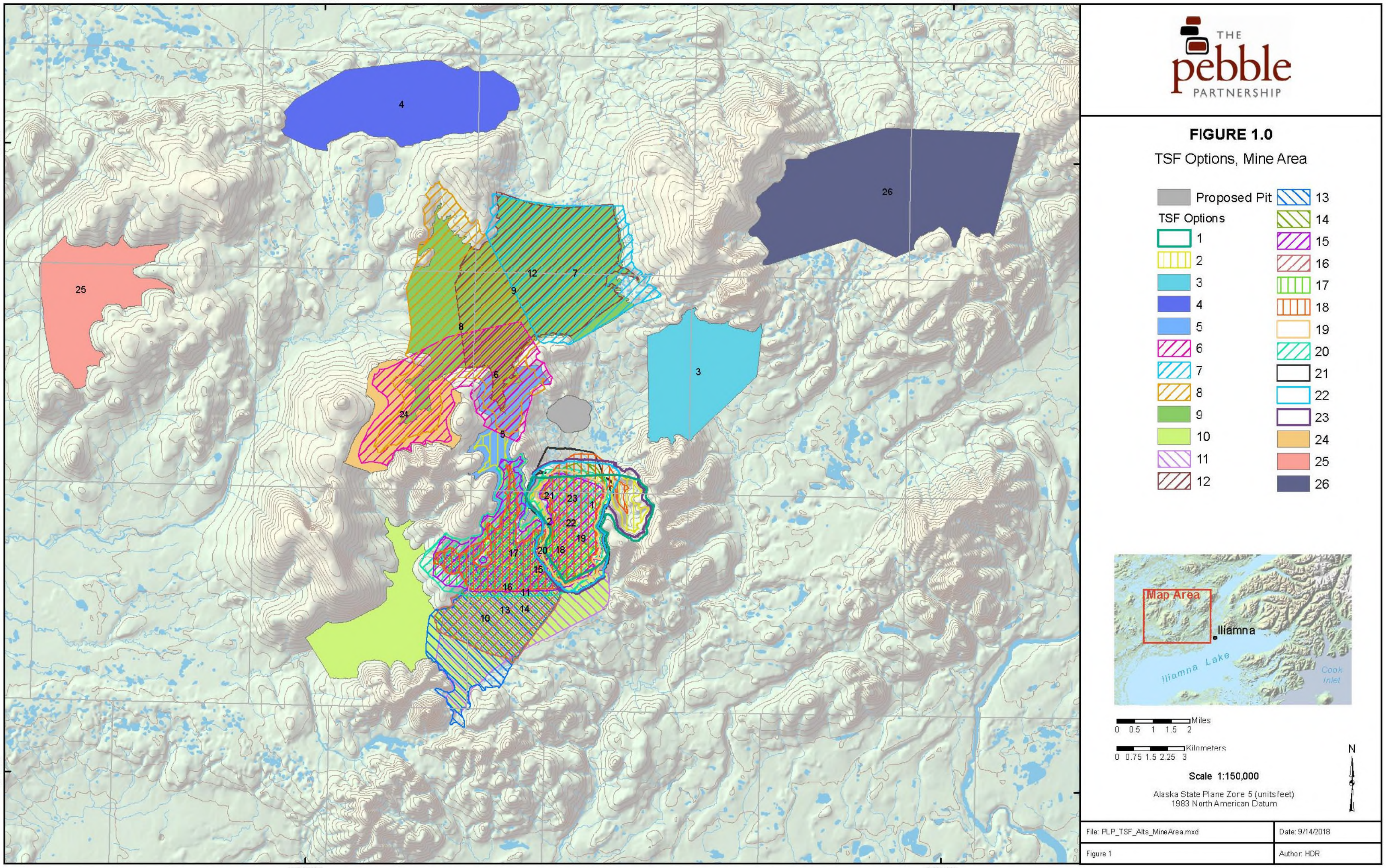
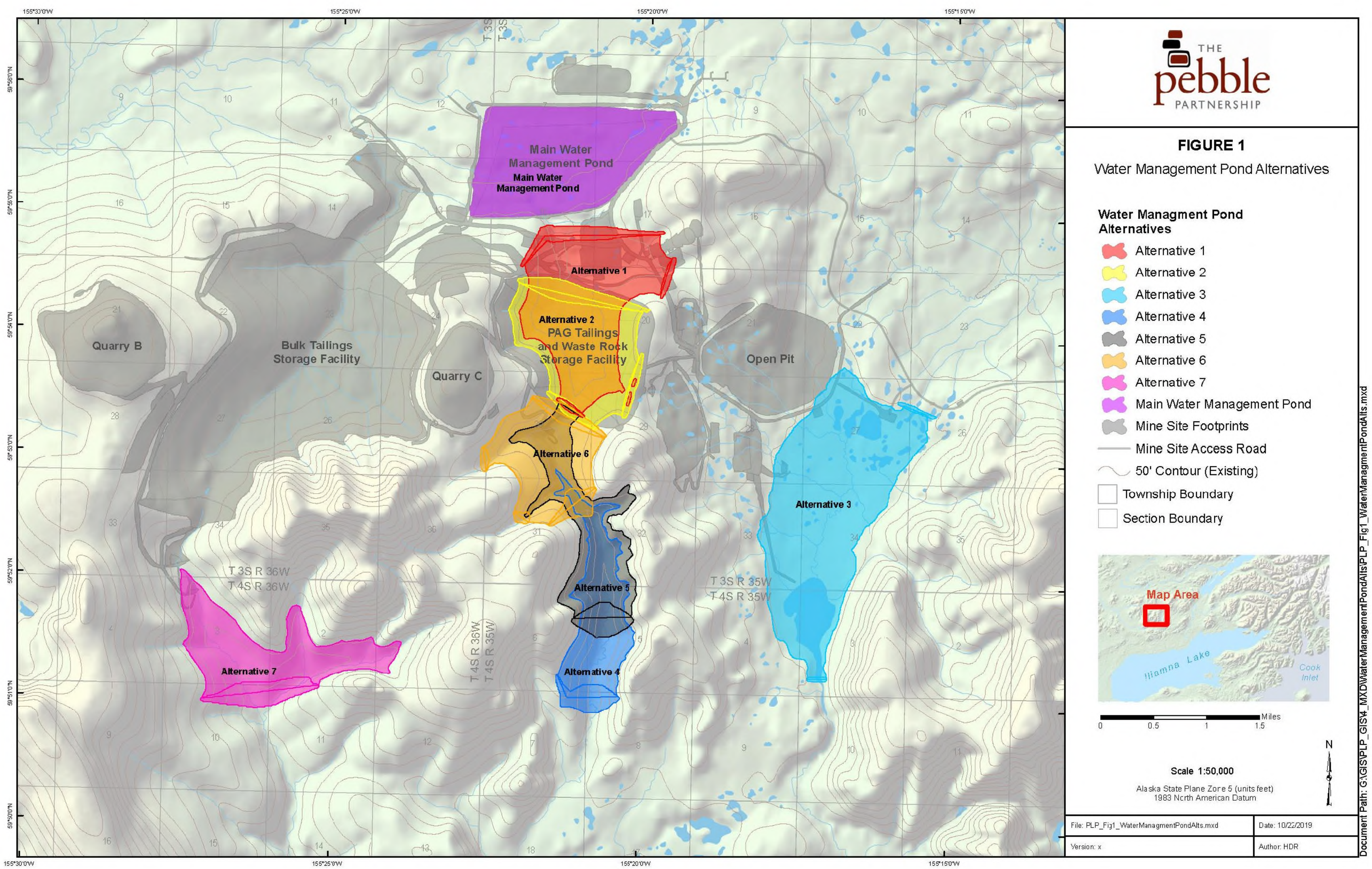


Figure 2-3. Optional locations for siting the Main Water Management Pond evaluated within the FEIS. Figure 1 from PLP (2019d: RFI 150).



2.2 Background

2.2.1 Timeline of Key Events Related to the Pebble Deposit (1984–October 2021)

In 1984, the State of Alaska adopted the *Bristol Bay Area Plan for State Lands* (BBAP). The 1984 BBAP placed fish and wildlife habitat and harvest as a primary use throughout the Bristol Bay study area (ADNR 1984a). To carry out its goals, the 1984 BBAP included Mineral Closing Order (MCO) 393, along with 18 other MCOs, which closed the stream channel plus 100 feet on either side of designated anadromous reaches of 64 streams in the Bristol Bay region to new mineral entry. Implementing MCO 393 was consistent with ADNR's determination that new mineral entry "creates an incompatible surface use conflict with salmon propagation and production, and jeopardizes the economy of the Bristol Bay region and the management of the commercial, sport, and subsistence fisheries in the Bristol Bay area" (ADNR 1984b: Page 2). The BBAP was subsequently amended in 2005 and 2013, but the MCOs established by the initial 1984 BBAP were not affected by these amendments.[18] While the protections associated with MCO 393 apply to portions of the SFK, NFK, and UTC located downstream of the Pebble deposit,[19] the portions of SFK, NFK, and UTC and their tributaries that overlie the Pebble deposit and would be directly affected by the 2020 Mine Plan are not covered by MCO 393.

The Pebble deposit was first explored by Cominco Alaska, a division of Cominco Ltd, now Teck, between 1985 and 1997, with exploratory drilling between 1988 and 1997 (Ghaffari et al. 2011). In November 1987, Teck staked claims in the Pebble prospect and added claims to that area in July 1988. In 2001, Northern Dynasty Minerals Ltd. (NDM) acquired claims related to the Pebble deposit. From 2001 to 2019, NDM, and subsequently PLP,[20] conducted significant mineral exploration at the Pebble deposit, including deposit delineation, and developed environmental, socioeconomic, and engineering studies of the Pebble deposit (Kalanchey et al. 2021).

Beginning in 2004, NDM engaged with USACE in pre-CWA Section 404 permit application meetings. Through these meetings, USACE confirmed that NDM/PLP would need a CWA Section 404 permit to develop a mine at the Pebble deposit and that the permit review process would include a public interest

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[18] The 2013 BBAP designates land uses in the footprint of the 2020 Mine Plan. The 2013 BBAP specifies that these lands are to be retained in public ownership and managed for multiple uses—including recreation, timber, minerals, and fish and wildlife—as well as natural scenic, scientific, and historic values (USACE 2020b). This specification does not preclude construction of the mine and related facilities, and the State of Alaska has made no specific determinations whether the 2020 Mine Plan is consistent with the BBAP (USACE 2020b).

[19] Specifically, MCO 393 closed the designated anadromous portions of the South Fork Koktuli River (AWC # 325-30-10100-2202-3080), North Fork Koktuli River (AWC # 325-30-10100-2202-3080-4083), and Upper Talarik Creek (AWC # 324-10-10150-2183), as well as any state-owned lands 100 feet from ordinary high water (on both sides of the stream) to new mineral entry (ADNR 1984b).

[20] PLP was created in 2007 by co-owners NDM and Anglo American PLC to design, permit, construct, and operate a long-life mine at the Pebble deposit (Ghaffari et al. 2011). In 2013, NDM acquired Anglo American's interest in PLP, and NDM now holds a 100 percent interest in PLP (Kalanchey et al. 2021).

review, development of an environmental document in accordance with NEPA, and a review for compliance with the CWA Section 404(b)(1) Guidelines (Lestochi pers. comm.).

Also in 2004, EPA Region 10 met numerous times with NDM to discuss the potential environmental impacts associated with developing a mine at the Pebble deposit, including early environmental baseline study plans and preparation for the review of the mine project pursuant to NEPA and Section 404 of the CWA. Later that year, NDM established and began coordinating a Baseline Environmental Team of federal and state agency technical staff, including EPA Region 10, to continue reviewing the draft environmental baseline study plans. NDM also provided periodic updates on its process to develop a mine, as well as findings from its environmental baseline studies and findings related to cultural resources that could be affected.

In 2006, NDM submitted water rights permit applications to ADNR for water rights to use UTC and the Koktuli River in mining operations (NDM 2006). In total, NDM applied for rights to approximately 35 billion gallons of groundwater and surface water per year (ADNR 2022b).

Between 2007 and 2010, nine state and federal agencies, including Alaska Department of Fish and Game (ADF&G), ADNR, National Marine Fisheries Service (NMFS), National Park Service (NPS), USACE, U.S. Fish and Wildlife Service (USFWS), and EPA Region 10 participated in the Pebble Project Technical Working Group, which was formed by PLP to facilitate coordinated agency review of environmental studies to support future NEPA and subsequent permitting actions (ADNR 2022b).

On May 2, 2010, former EPA Administrator Lisa P. Jackson and former Region 10 Regional Administrator Dennis McLerran received a letter from six federally recognized Bristol Bay tribal governments requesting that EPA initiate a process under Section 404(c) of the CWA to protect waters, wetlands, fishes, wildlife, fisheries, subsistence, and public uses in the Nushagak and Kvichak River watersheds and Bristol Bay from metallic sulfide mining, including a potential Pebble mine. Signatories included Nondalton Tribal Council, New Stuyahok Traditional Council, Levelock Village Council, Ekwok Village Council, Curyung Tribal Council, and Koliganek Village Council. Subsequently, three additional federally recognized Bristol Bay tribal governments signed this letter: Native Village of Ekuk, Village of Clark's Point, and Twin Hills Village Council.

Following the letter from the tribes, EPA and former President Obama received numerous letters from additional partners and stakeholders expressing their interests and concerns regarding potential EPA action to protect Bristol Bay fishery resources. Some requests favored immediate action to comprehensively protect Bristol Bay, including a public process under Section 404(c) of the CWA. Others favored a targeted CWA Section 404(c) action that would restrict only mining associated with the Pebble deposit. In addition to other Bristol Bay tribes, EPA received letters from the Bristol Bay Native Association, the Bristol Bay Native Corporation, other tribal organizations, stakeholder groups dependent on the fishery (i.e., commercial and recreational fishers, seafood processors and marketers, chefs and restaurant and supermarket owners, and sport fishing and hunting lodge owners and guides), sporting goods manufacturers and vendors, a coalition of jewelry companies, conservation organizations, members of the faith community, and elected officials from Alaska and other states.

Other requests received during this time urged EPA to refrain from taking action under CWA Section 404(c). These requests included those that asked for more time to understand potential implications of mine development in the Bristol Bay watershed. Others requested EPA wait until formal mine permit applications had been submitted and an EIS had been developed. These requestors included four federally recognized Bristol Bay tribal governments (Newhalen Tribal Council, South Naknek Tribal Council, King Salmon Traditional Village Council, and Iliamna Village Council), other tribal organizations, former Governor Parnell of Alaska, and attorneys representing PLP.

In response to requests, EPA met with tribal governments and stakeholders, including those that supported and those that opposed a mine at the Pebble deposit, to hear their concerns and receive any information they wished to provide. These meetings occurred in the villages in the Bristol Bay watershed and in Anchorage, Alaska, Seattle, Washington, and Washington, DC.

Former EPA Administrator Jackson and former Region 10 Regional Administrator McLerran visited Alaska in August 2010 to learn about the challenges facing rural Alaska towns and Alaska Native villages. Their itinerary included a meeting with PLP for a briefing on the proposed mining of the Pebble deposit. They also visited Dillingham, where they participated in two listening sessions, one specifically for tribal leaders from Bristol Bay and one meeting open to all local and regional entities.

In February 2011, NDM submitted a preliminary assessment for mining the Pebble deposit to the U.S. Securities and Exchange Commission (SEC) (SEC 2011) entitled *Preliminary Assessment of the Pebble Project, Southwest Alaska* (Ghaffari et al. 2011). The preliminary assessment described three stages of mine development at the Pebble deposit: an initial 2-billion-ton mine consisting of 25 years of open-pit mining, a 3.8-billion-ton mine consisting of 45 years of open-pit mining, and a 6.5-billion-ton mine consisting of 78 years of open-pit mining. The preliminary assessment also indicated that the total Pebble mineral resource might approach 11 billion tons of ore.

Also in February 2011, in response to the competing requests regarding CWA Section 404(c) described previously, former Region 10 Regional Administrator McLerran announced EPA's intent to conduct a scientific assessment to evaluate how future large-scale mining projects might affect water quality and Bristol Bay's salmon fishery. This ecological risk assessment was ultimately entitled *Assessment of Potential Mining Impacts on Salmon Ecosystems of Bristol Bay, Alaska* (Bristol Bay Assessment or BBA).[21] Concurrent with this announcement, EPA Region 10 notified by letter 31 Bristol Bay tribes, ADEC, ADF&G, ADNR, the Bureau of Land Management, NMFS, NPS, USACE, USFWS, and the U.S. Geological Survey (USGS) of its intent to develop the BBA. The same week, EPA Region 10 met with Nuna Resources, which represents several Alaska Native Claims Settlement Act (ANCSA) Village Corporations,[22] and had meetings with other partners and stakeholders. NFMS, USFWS, and USGS

[21] EPA conducted the BBA consistent with its authority under CWA Section 104(a) and (b).

[22] Congress created Regional and Village Corporations (Alaska Native Corporations) to manage the lands, funds, and other assets conveyed to Alaska Natives by ANCSA.

worked closely with EPA on the development of the BBA, including authoring appendices to the BBA (see Table 2-1 for a timeline of BBA development).[23]

In December 2011, PLP provided EPA Region 10 with an advance, embargoed copy of its more than 25,000-page environmental baseline document, which presented the results of baseline studies conducted from 2004 through 2008 (PLP 2011). The environmental baseline document was designed to characterize the existing physical, chemical, biological, and social environments in the SFK, NFK, and UTC watersheds where the Pebble deposit is located, as well as the proposed mine's transportation corridor that would link the mine site to a proposed port site on Cook Inlet. The extensive environmental baseline document developed by PLP (PLP 2011) and NDM's preliminary assessment for mining the Pebble deposit that was submitted to the SEC in February 2011 (Ghaffari et al. 2011) were key resources used in the development of the BBA.

EPA's purpose in conducting the BBA was to characterize the biological and mineral resources of the Bristol Bay watershed; increase understanding of the potential impacts of large-scale mining on the region's fish resources, in terms of both day-to-day operations and potential accidents and failures; and inform future decisions by government agencies and others related to protecting and maintaining the chemical, physical, and biological integrity of the watershed. The BBA represents a review and synthesis of information available at that time to identify and evaluate potential risks of future large-scale mining development on the Bristol Bay watershed's fish habitats and populations and consequent effects on the region's wildlife and Alaska Native communities.

Table 2-1. Bristol Bay Assessment timeline.

2/7/2011	Announced intent to conduct the BBA.
8/2011	Met with Intergovernmental Technical Team to gather information to inform the scope of the BBA.
2/24/2012	Invited the public to nominate qualified experts to be considered for the external peer review panel.
3/2012	Distributed internal review draft of the BBA for Agency technical review.
5/18/2012	Released first external review draft of the BBA for public comment and external peer review.
5/31/2012 and 6/4–7/2012	Held public meetings in Dillingham, Naknek, New Stuyahok, Nondalton, Levelock, Igiugig, Anchorage, and Seattle to communicate the results of the draft BBA and receive public comments.
6/5/2012	Announced the names of the 12 independent peer reviewers to review the draft BBA and released the draft charge questions, providing the public the opportunity to comment on the draft charge questions.
8/7–9/2012	Held external peer review meeting in Anchorage.
11/2012	Released the final peer review report containing the external peer review of the May 2012 draft of the BBA.
4/30/2013	Released second external review draft of the BBA for public comment and follow-on review by external peer reviewers, to evaluate how well the second external review draft responded to peer reviewers' comments on the first external review draft.
1/15/2014	Released the final BBA and EPA Response to Peer Review Comments document.
3/21/2014	Released EPA Response to Public Comments documents.

[23] For more information about EPA's efforts in Bristol Bay or copies of the Bristol Bay Assessment, see http://www.epa.gov/bristolbay.

Meaningful engagement with tribal governments, Alaska Native Corporations, and all stakeholders was essential to ensure that EPA heard and understood the full range of perspectives on both the BBA and potential effects of mining in the region. EPA released two drafts of the BBA for public comment. Approximately 233,000 and 890,000 comments were submitted to the EPA docket during the 60-day public comment periods for the May 2012 and April 2013 drafts, respectively. EPA also held eight public comment meetings in May and June 2012 in Dillingham, Naknek, New Stuyahok, Nondalton, Levelock, Igiugig, Anchorage, and Seattle. Approximately 2,000 people attended these meetings. An overview of these meetings was shared via two webinars in July 2012.

Consistent with Executive Order 13175, entitled *Consultation and Coordination with Indian Tribal Governments*, and EPA Region 10 Tribal Consultation and Coordination Procedures (EPA 2012), EPA Region 10 invited all 31 Bristol Bay tribal governments to participate in consultation and coordination on both drafts of the BBA. Pursuant to Public Law 108-199, 118 Stat. 452, as amended by Public Law 108-447, 118 Stat. 3267, EPA also invited all 26 Alaska Native Corporations in Bristol Bay to participate in engagement on both drafts of the BBA. Throughout the development of the BBA, 20 tribal governments and one tribal consortium participated in the consultation and coordination process, and 17 Alaska Native Corporations participated in the engagement process.

The BBA also underwent external peer review by a panel of 12 independent experts (Table 2-1). The peer review panel reviewed the May 2012 draft and provided EPA with their comments. A 3-day peer review meeting was held in Anchorage on August 7 through 9, 2012, during which peer reviewers heard testimony from approximately 100 members of the public. The peer review panel also reviewed the April 2013 draft and provided EPA with a second round of comments that evaluated whether the April 2013 draft was responsive to their original comments.

In January 2014, EPA released both the final BBA (EPA 2014) and the final Response to Peer Review Comments document. In March 2014, EPA released the final Response to Public Comments documents for both the May 2012 and April 2013 drafts of the BBA.

On February 28, 2014, after careful consideration of available information, including information collected as part of the BBA, other existing scientific and technical information, and extensive information provided by stakeholders, EPA Region 10 notified USACE, the State of Alaska, and PLP that it had decided to proceed under the CWA Section 404(c) regulations, 40 CFR 231, to review potential adverse environmental effects of discharges of dredged or fill material associated with mining the Pebble deposit. EPA Region 10 stated that it was taking this step because it had reason to believe that porphyry copper mining of the scale contemplated at the Pebble deposit could result in unacceptable adverse effects on fishery areas. In accordance with the regulation at 40 CFR 231.3(a)(1), EPA Region 10 provided USACE, the State of Alaska, and PLP an opportunity to submit information for the record, to demonstrate to the satisfaction of the EPA Region 10 Regional Administrator that no unacceptable adverse effects on aquatic resources would result from discharges associated with mining the Pebble deposit, or that USACE intended to take corrective action to prevent unacceptable adverse effects satisfactory to the EPA Region 10 Regional Administrator.

Also on February 28, 2014, EPA Region 10 invited all 31 Bristol Bay tribal governments to participate in tribal consultation, and all 26 Alaska Native Corporations to participate in consultation and engagement on the 2014 Proposed Determination. In total, 17 tribal governments participated in the consultation process, and 6 Alaska Native Corporations participated in the consultation and engagement process.

EPA Region 10 held two meetings on March 25, 2014, one with PLP executives and one with the Alaska Attorney General. On April 29, 2014, PLP and the Alaska Attorney General separately provided information as part of the initial CWA Section 404(c) consultation period. In these submittals, PLP and the Alaska Attorney General raised several legal, policy, scientific, and technical issues, including questions regarding EPA's authority to initiate a CWA Section 404(c) review before PLP had submitted a CWA Section 404 permit application to USACE, the scientific credibility of the BBA, and whether the BBA should be used to inform decision-making under CWA Section 404(c). Most of the scientific and technical issues detailed in these documents had been raised before; EPA had provided responses to these issues in individual correspondence to PLP and the Alaska Attorney General and, most comprehensively, in the 400-page BBA Response to Peer Review Comments document released in January 2014 and the 1,200-page BBA Response to Public Comments documents released in March 2014.

By letter dated March 14, 2014, USACE responded to EPA's February 28, 2014 letter. In its response, USACE did not notify the Regional Administrator of its intent to take corrective action to prevent an unacceptable adverse effect.

After fully considering the April 29, 2014 submittals from PLP and the Alaska Attorney General and the March 14, 2014 letter from USACE, the EPA Region 10 Regional Administrator was not satisfied that no unacceptable adverse effect could occur and USACE did not notify the Regional Administrator of its intent to take corrective action to prevent an unacceptable adverse effect. Thus, EPA Region 10 decided to take the next step in the CWA Section 404(c) process, publication of a proposed determination.

On July 21, 2014, EPA Region 10 published in the *Federal Register* a Notice of Proposed Determination under Section 404(c) of the CWA to restrict the use of certain waters in the SFK, NFK, and UTC watersheds as disposal sites for dredged or fill material associated with mining the Pebble deposit (79 FR 42314, July 21, 2014). The notice started a public comment period that ended on September 19, 2014. EPA Region 10 also held seven hearings during the week of August 11, 2014. These hearings took place in Anchorage, Nondalton, New Stuyahok, Dillingham, Kokhanok, Iliamna, and Igiugig. More than 830 community members participated in the seven hearings, more than 300 of whom provided oral statements. In addition to testimony taken at the hearings, EPA Region 10 received more than 670,000 written comments during the public comment period, more than 99 percent of which supported the 2014 Proposed Determination. The public comments and transcripts from the public hearings can be found in the docket for the 2014 Proposed Determination.[24]

[24] Information regarding the 2014 Proposed Determination can be found in the docket for this effort at www.regulations.gov, docket ID No. EPA-R10-OW-2014-0505.

Before EPA could reach the next step in the CWA Section 404(c) review process—to either withdraw the 2014 Proposed Determination or prepare a recommended determination pursuant to 40 CFR 231.5(a)—PLP filed multiple lawsuits against the Agency. On November 25, 2014, the U.S. District Court for the District of Alaska (District Court) issued a preliminary injunction against EPA in one of those lawsuits, which halted EPA Region 10's CWA Section 404(c) review process until the case was resolved (Order Granting Preliminary Injunction at 1-2, Pebble Limited Partnership v. EPA, No. 3:14-cv-00171 (D. Alaska Nov. 25, 2014)). On May 11, 2017, EPA and PLP settled that lawsuit, as well as PLP's other outstanding lawsuits, and the court subsequently dissolved the injunction and dismissed the case with prejudice.

Under the terms of the settlement, EPA agreed to "initiate a process to propose to withdraw the Proposed Determination" by July 11, 2017. EPA also agreed not to forward a signed recommended determination to EPA Headquarters until May 11, 2021, or until EPA published a notice of USACE's FEIS on PLP's CWA Section 404 permit application for the proposed Pebble mine, whichever came first. To take advantage of this period of forbearance, PLP was required to submit its CWA Section 404 permit application to USACE within 30 months of execution of the settlement agreement.[25]

On July 11, 2017, EPA signed a *Federal Register* notice that initiated the process and proposed to withdraw the 2014 Proposed Determination. Also on July 11, 2017, EPA invited all 31 Bristol Bay tribal governments to participate in consultation and coordination, and all 26 Alaska Native Corporations to participate in consultation on the 2017 proposal to withdraw. In total, 18 tribal governments and 3 Alaska Native Corporations participated in the consultation processes.

On July 19, 2017, in accordance with the terms of the settlement agreement, EPA Region 10 published in the *Federal Register* a notice of its proposal to withdraw the 2014 Proposed Determination (82 FR 33123, July 19, 2017). EPA stated that the Agency was proposing to withdraw the 2014 Proposed Determination because it would (1) provide PLP with additional time to submit a CWA Section 404 permit application to USACE; (2) remove any uncertainty, real or perceived, about PLP's ability to submit a permit application and have that permit application reviewed; and (3) allow the factual record regarding any forthcoming permit application to develop. EPA explained that "[i]n light of the basis upon which EPA is considering withdrawal of the Proposed Determination, EPA is not soliciting comment on the proposed restrictions or on science or technical information underlying the Proposed Determination" (82 FR 33124, July 19, 2017).

The July 19, 2017 notice started a public comment period that ended on October 17, 2017. EPA also held hearings in Dillingham and Iliamna the week of October 9, 2017. EPA received more than one million public comments regarding its proposal to withdraw the 2014 Proposed Determination. Approximately 99 percent of commenters expressed opposition to the withdrawal of the 2014 Proposed Determination. The public comments, transcripts from the public hearings, and summaries of the tribal and Alaska

[25] For a copy of the settlement agreement, *see* https://www.epa.gov/bristolbay/2017-settlement-agreement-between-epa-and-pebble-limited-partnership.

Native Corporation consultations can be found in the docket for the 2017 proposal to withdraw the 2014 Proposed Determination.[26]

On December 22, 2017, PLP submitted to USACE a CWA Section 404 permit application for the discharge of dredged and fill material to waters of the United States to develop a mine at the Pebble deposit, as well as associated infrastructure (e.g., ports, roads, and pipelines). On January 5, 2018, USACE issued a public notice that provided PLP's permit application to the public and stated that an EIS would be required as part of its permit review process, consistent with NEPA. USACE also invited relevant federal, state, and local agencies, as well as tribal governments, to be cooperating agencies on the development of this EIS. EPA, the United States Coast Guard, the Bureau of Safety and Environmental Enforcement, the Advisory Council on Historic Preservation, USFWS, NPS, the Pipeline and Hazardous Materials Safety Administration, the State of Alaska, the Lake and Peninsula Borough, the Curyung Tribal Council, and the Nondalton Tribal Council accepted the USACE invitation and became NEPA cooperating agencies.

On January 26, 2018, EPA Region 10 announced a “suspension” of the proceeding to withdraw the 2014 Proposed Determination. This action was published in the *Federal Register* on February 28, 2018 (83 FR 8668, February 28, 2018).

On March 29, 2018, USACE published in the *Federal Register* a Notice of Intent to prepare an EIS and a Notice of Scoping for the Pebble Project (83 FR 13483, March 29, 2018). The EIS scoping public comment period opened on April 1, 2018 and closed on June 29, 2018. USACE received 174,889 total submissions during the scoping comment period, which are summarized in the FEIS, Appendix A. On June 29, 2018, EPA Region 10 submitted a comment letter to USACE, pursuant to the White House Council on Environmental Quality (CEQ) NEPA regulations and Section 309 of the Clean Air Act (CAA), that contained recommendations for the EIS in response to the scoping process.

On March 1, 2019, USACE released the DEIS for public comment. Also on March 1, 2019, USACE published a public notice soliciting comment on PLP’s CWA Section 404 permit application (Public Notice POA-2017-00271). The public comment period for both the DEIS and the CWA Section 404 permit application opened on March 1, 2019 and closed July 1, 2019. USACE also held nine public hearings on the DEIS throughout March and April 2019. USACE received 311,885 public comments on the DEIS, which are summarized in the FEIS, Appendix D. USACE held public hearings on the DEIS in Naknek, Kokhanok, Newhalen, Igiugig, New Stuyahok, Nondalton, Dillingham, Homer, and Anchorage, Alaska.

On July 1, 2019, EPA sent a letter to USACE with its comments and recommendations on the DEIS, pursuant to EPA’s review responsibilities under the CEQ NEPA regulations and CAA Section 309 (EPA 2019b). On July 1, 2019, EPA sent a separate letter to USACE with comments on the CWA Section 404 permit public notice (EPA 2019a). These EPA comment letters included more than 160 pages of comments in which EPA identified substantial potential impacts and risks of the proposed project.

[26] Information regarding the proposal to withdraw can be found in the docket for this effort at www.regulations.gov, see docket ID No. EPA-R10-OW-2017-0369.

On August 30, 2019, after conferring with EPA's General Counsel,[27] EPA Region 10 published in the *Federal Register* its decision to withdraw the 2014 Proposed Determination, thereby concluding the withdrawal process that was initiated on July 19, 2017 (84 FR 45749, August 30, 2019). EPA identified that it was withdrawing the 2014 Proposed Determination because (1) new information had been generated since 2014, including information and preliminary conclusions in USACE's DEIS, which EPA would need to consider before any potential future decision-making regarding the matter; (2) the record would continue to develop throughout the permitting process; and (3) EPA could and then had initiated the CWA Section 404(q) Memorandum of Agreement dispute resolution process[28] and it was appropriate to use that process to resolve issues before engaging in any potential future decision-making regarding the matter.

In its August 30, 2019 notice of withdrawal of the 2014 Proposed Determination, EPA stated that "[a]s in EPA's prior notices, EPA is not basing its decision-making on technical consideration or judgments about whether the mine proposal will ultimately be found to meet the requirements of the 404(b)(1) Guidelines or results in 'unacceptable adverse effects' under CWA section 404(c)" (84 FR 45756, August 30, 2019).

In October 2019, twenty tribal, fishing, environmental, and conservation groups challenged EPA's withdrawal of the 2014 Proposed Determination in the District Court. The District Court granted EPA's motion to dismiss the case.

In February 2020, USACE released the preliminary FEIS to the cooperating agencies for comment. EPA Region 10 submitted comments and recommendations to the USACE on the preliminary FEIS on March 26, 2020.

From March 12, 2020 through May 28, 2020, an interagency team of managers and scientific and technical staff from USACE, EPA, and USFWS met weekly to evaluate the proposed project for compliance with the CWA Section 404(b)(1) Guidelines.

Based on its review of the CWA Section 404(b)(1) Guidelines, USACE determined that EIS Alternative 3 (North Road Only with concentrate and return water pipelines) was the least environmentally damaging practicable alternative (LEDPA). In June 2020, PLP submitted to USACE a revised permit application (i.e., the 2020 Mine Plan) to incorporate changes to the project based on USACE's LEDPA determination

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[27] See footnote 13 in Section 1.

[28] CWA Section 404(q) directs the Secretary of the Army to enter into agreements with various federal agencies, including EPA "to minimize, to the maximum extent practicable, duplication, needless paperwork, and delays in the issuance of permits under this section" (33 U.S.C. 1344(q)). EPA and USACE have entered into various agreements pursuant to Section 404(q). The operative agreement was entered in 1992. Part IV, paragraph 3 of the 1992 EPA and Army Memorandum of Agreement to implement Section 404(q) (hereinafter referred to as the "404(q) MOA") sets forth the "exclusive procedures" for elevation of individual permits cases (EPA and DA 1992).

(USACE 2020b). USACE determined that the changes to the project described in the revised permit application were not significant enough to warrant development of a Supplemental DEIS.[29]

On July 24, 2020, USACE published a Notice of Availability for the FEIS in the *Federal Register* (USACE 2020a).

On November 20, 2020, USACE issued its ROD denying PLP's CWA Section 404 permit application on the basis that the proposed project would not comply with the CWA Section 404(b)(1) Guidelines and would be contrary to the public interest (USACE 2020b). The USACE permit denial addresses only PLP's specific permit application. By letter dated November 25, 2020, USACE notified PLP that the proposed project failed to comply with the CWA Section 404(b)(1) Guidelines because "the proposed project would cause unavoidable adverse impacts to aquatic resources which would result in Significant Degradation to aquatic resources" (USACE 2020b: Transmittal Letter, Page 1) and that PLP's compensatory mitigation plan submitted to USACE on November 4, 2020, did not alter that finding.

On January 19, 2021, PLP filed a request for an appeal of the USACE permit denial with USACE, pursuant to 33 CFR Part 331. USACE accepted the appeal on February 25, 2021. USACE's review of the appeal is ongoing.

On June 17, 2021, the Ninth Circuit Court of Appeals reversed the District Court's decision to dismiss the tribal, fishing, environmental, and conservation groups' challenge to EPA's withdrawal of the 2014 Proposed Determination. The Ninth Circuit concluded that under EPA's regulations at 40 CFR 231.5(a), EPA is authorized to withdraw a proposed determination "*only* if the discharge of materials would be unlikely to have an unacceptable adverse effect." *Trout Unlimited v. Pirzadeh*, 1 F.4th 738, 757 (9th Cir. 2021) (emphasis in original). The Ninth Circuit remanded the case to the District Court for further proceedings.

On September 28, 2021, EPA filed a motion in the District Court requesting that the court vacate the Agency's 2019 decision to withdraw the 2014 Proposed Determination and remand the action to the Agency for reconsideration. The District Court granted EPA's motion on October 29, 2021.

2.2.2 Re-initiation of Clean Water Act Section 404(c) Review Process (November 2021–Present)

The District Court's vacatur of EPA's 2019 decision to withdraw the 2014 Proposed Determination had the effect of reinstating the 2014 Proposed Determination and reinitiating EPA's CWA Section 404(c) review process. Because the next step in the CWA Section 404(c) review process required the EPA Region 10 Regional Administrator to, within 30 days, decide whether to withdraw the 2014 Proposed Determination or prepare a recommended determination, EPA Region 10 published in the *Federal Register* on November 23, 2021, a notice extending the applicable time requirements through May 31, 2022, to consider available information and determine the appropriate next step in the CWA Section

[29] PLP also submitted an updated permit application to USACE in December 2019 and USACE made a similar finding at that time that a Supplemental DEIS was not warranted.

404(c) review process. In its notice, EPA concluded that it should consider information that has become available since EPA issued the 2014 Proposed Determination.

On January 27, 2022, EPA Region 10 notified USACE, ADNR, PLP, Pebble East Claims Corporation, Pebble West Claims Corporation, and Chuchuna Minerals[30] (the Parties) of EPA's intention to issue a revised proposed determination because, based on EPA Region 10's evaluation to date of available information, it continued to have reason to believe that the discharge of dredged or fill material associated with mining the Pebble deposit could result in unacceptable adverse effects on fishery areas. A copy of EPA Region 10's January 27, 2022 letter can be found in Appendix A.

Also on January 27, 2022, consistent with Executive Order 13175,[31] entitled Consultation and Coordination with Indian Tribal Governments, and EPA Region 10 Tribal Consultation and Coordination Procedures (EPA 2012), EPA Region 10 invited all 31 Bristol Bay tribal governments to participate in consultation. Separately, it also invited consultation with 5 Alaska Native Corporations and offered engagement to 21 Alaska Native Corporations with lands in the Bristol Bay watershed. EPA Region 10 hosted three informational webinars for tribal governments and one informational webinar for Alaska Native Corporations to review the CWA Section 404(c) process and answer questions. In addition, EPA Region 10 engaged in multiple consultations with tribal governments and Alaska Native Corporations from February through October 2022.

Consistent with EPA's CWA Section 404(c) regulations at 40 CFR 231.3(a)(1), EPA Region 10 provided the Parties with the opportunity to submit information for the record to demonstrate to the satisfaction of the EPA Region 10 Regional Administrator that no unacceptable adverse effects on aquatic resources would result from discharges associated with mining the Pebble deposit or that USACE intended to take corrective action to prevent unacceptable adverse effects satisfactory to the EPA Region 10 Regional Administrator. Consistent with EPA's CWA Section 404(c) regulations, EPA requested that the Parties respond by February 11, 2022. On January 29, 2022, PLP requested a total of 45 days—through March 28, 2022—to provide its submission. EPA granted this request and provided the same extension to all Parties.

EPA Region 10 met with Chuchuna Minerals on February 9, 2022, and with PLP on February 18, 2022. On March 28, 2022, ADNR, PLP, and Chuchuna Minerals separately provided information as part of the initial CWA Section 404(c) consultation period. In these submittals, ADNR, PLP, and Chuchuna Minerals raised several legal, policy, scientific, and technical issues, including questions regarding continued reliance on the 2014 Proposed Determination; EPA's authority and justification for undertaking a CWA Section 404(c) review at this time; whether the 2020 Mine Plan's potential impacts on fishery areas warrant review pursuant to CWA Section 404(c); and whether a CWA Section 404(c) action would

[30] EPA Region 10 included Chuchuna Minerals in this notification step because USACE's FEIS for the 2020 Mine Plan indicates that discharges associated with mining the Pebble deposit could expand in the future into portions of areas where Chuchuna Minerals holds mining claims.

[31] On January 26, 2021, President Biden issued the Presidential Memorandum, *Tribal Consultation and Strengthening Nation-to-Nation Relationships*, which charges each federal agency to engage in regular, meaningful, and robust consultation and to implement the policies directed in Executive Order 13175.

violate the rights established in the Alaska Statehood Act (ASA), Cook Inlet Land Exchange Act (CILEA), Alaska National Interest Lands Conservation Act (ANILCA), ANCSA, and the Federal Land Policy and Management Act (FLPMA).

USACE did not request a meeting or provide information as part of this initial CWA Section 404(c) consultation period.

Below is a brief summary of the issues raised in responses to EPA Region 10's January 27, 2022 notification letters and a brief summary of EPA's assessment of the information.

- **Continued reliance on the 2014 Proposed Determination.** PLP referred to the 2014 Proposed Determination as "obsolete," and PLP and ADNR indicated that it would not be appropriate for EPA Region 10 to continue to rely on the document. EPA Region 10 recognized that the scientific and technical record for the development of a mine at the Pebble deposit has evolved since it issued the 2014 Proposed Determination and, as stated in its November 23, 2021 *Federal Register* Notice, agreed that EPA should consider information that had become available since the Agency issued the 2014 Proposed Determination in any CWA Section 404(c) review process for the Pebble deposit area. Accordingly, based on consideration of information that had become available since the issuance of the 2014 Proposed Determination, EPA Region 10 issued the 2022 Proposed Determination.
- **EPA's authority and justification for undertaking a CWA Section 404(c) review at this time.** PLP took the position that EPA's use of CWA Section 404(c) now is unnecessary because EPA could use its CWA Section 404(c) authority later if USACE's permit denial is overturned, or if a new permit application is submitted in the future. ADNR took the position that use of CWA Section 404(c) would be premature because it believes USACE's permit denial inappropriately terminated the permit review process and that "critical information on the effects and measures the agencies would employ to avoid and minimize [project] impacts was not completed or published." EPA has fully considered these issues and provides its rationale for pursuing a CWA Section 404(c) review at this time in Section 2.2.3 of this final determination.
- **Whether the 2020 Mine Plan's potential impacts on fishery areas warrant review pursuant to CWA Section 404(c).** ADNR, PLP, and Chuchuna Minerals questioned the basis for EPA Region 10's concerns that a mine at the Pebble deposit could adversely affect fishery areas. ADNR and PLP provided quotes from the 2020 Mine Plan's FEIS, which suggest that the 2020 Mine Plan's impacts on fishes would not be "measurable." As discussed in detail in Sections 3 and 4, as well as in Appendix B of this final determination, EPA has determined that information in the FEIS and other parts of the record indicates that certain discharges of dredged or fill material associated with construction and routine operation of the 2020 Mine Plan will have unacceptable adverse effects on fishery areas.
- **Whether a CWA Section 404(c) action in this case would violate the rights established in the ASA, CILEA, ANILCA, ANCSA, and FLPMA.** ADNR and PLP took the position that any attempt by EPA to

preclude development within this area would violate the statutory compromises established in the ASA, CILEA, and ANILCA because the State of Alaska selected the lands where the Pebble deposit is located for its potential mining development and because ANILCA requires federal agencies to cooperate with the State to balance the national interest in Alaska's natural resources with recognition of Alaska's interests. For similar reasons, ADNR and PLP also took the position that restricting development of the Pebble deposit would run afoul of ANCSA because Alaska Native Corporations are required to develop and manage their lands to the benefit of their shareholders and a mine at the Pebble deposit would provide economic opportunity in the area. ADNR also argued that EPA's action would violate FLPMA by effectively withdrawing greater than 5,000 acres from mineral development without congressional approval. Nothing in the ASA, CILEA, ANILCA, ANCSA, or FLPMA, nor any other relevant authority, precludes the application of a duly enacted federal law, including Section 404(c) of the CWA, nor does any such law serve as a barrier to EPA's use of Section 404(c) of the CWA to prohibit the specification of or restrict the use for specification of defined areas as disposal sites for discharges of dredged or fill material into waters of the United States.

After fully considering the March 28, 2022 submittals from ADNR, PLP, and Chuchuna Minerals, the EPA Region 10 Regional Administrator was not satisfied that no unacceptable adverse effect could occur and USACE did not notify the Regional Administrator of its intent to take corrective action to prevent an unacceptable adverse effect. Thus, EPA Region 10 decided that the appropriate next step in the CWA Section 404(c) process for the Pebble deposit area was the publication of the 2022 Proposed Determination.

On May 26, 2022, EPA Region 10 published in the *Federal Register* a notice of availability for its 2022 Proposed Determination under Section 404(c) of the CWA to prohibit the specification of and restrict the use for specification of certain waters in the SFK, NFK, and UTC watersheds as disposal sites for the discharge of dredged or fill material associated with developing the Pebble deposit. The notice announced public hearings on the proposed determination (87 FR 32021, May 26, 2022) and started a public comment period that was scheduled to end on July 5, 2022.

On June 16 and 17, 2022, EPA Region 10 held three public hearings (in-person hearings in Dillingham and Iliamna, and one virtual hearing) on the proposed determination. More than 186 people participated in the three hearings, 111 of whom provided oral statements.

EPA Region 10 received several communications regarding an extension of the comment period, including requests to extend the comment period by 60 days and 120 days. EPA Region 10 also received requests not to extend the public comment period. EPA Region 10 considered each of these requests and found good cause existed pursuant to 40 CFR 231.8 to extend the public comment period through September 6, 2022, to provide sufficient time for all parties to meaningfully comment on the proposed determination and supporting documents. On June 30, 2022, a notice announcing extension of the public comment period and public hearing comment period was published in the *Federal Register* (87 FR 39091, June 30, 2022).

On September 6, 2022, EPA Region 10 published in the *Federal Register* a notice to extend the period for the EPA Region 10 Regional Administrator to evaluate public comments. EPA's regulations at 40 CFR 231.5(a) require that, within 30 days after the conclusion of public hearings (but not before the end of the comment period), the Regional Administrator either withdraw the proposed determination or prepare a recommended determination. Because the date of the last public hearing (June 17, 2022) was more than 30 days before the close of the public comment period (September 6, 2022), EPA would not have had time to review any of the public comments before the regulations required it to make its next decision. Accordingly, EPA Region 10 found good cause existed pursuant to 40 CFR 231.8 to extend the time period provided in 40 CFR 231.5(a) to either withdraw the proposed determination or to prepare a recommended determination through no later than December 2, 2022, to help ensure full consideration of the extensive administrative record, including all public comments (87 FR 54498, September 6, 2022).

In addition to the testimony taken at the hearings, EPA Region 10 received more than 582,000 written comments during the public comment period, approximately 99 percent of which expressed support for the proposed determination. The public comments and transcripts from the public hearings can be found in the docket for the proposed determination.[32] For more information regarding these comments and EPA's responses, see *Response to Comments on EPA's Clean Water Act Section 404(c) Determination for the Pebble Deposit Area* (EPA 2023a).

EPA Region 10 reviewed the extensive administrative record, including all public comments received on the proposed determination, and the Regional Administrator decided to prepare a recommended determination. On December 1, 2022, the Regional Administrator transmitted the recommended determination, along with its administrative record to EPA's Assistant Administrator for Water for review and final action.

On December 2, 2022, the Assistant Administrator for Water notified the Parties[33] that she had received EPA Region 10's recommended determination and the administrative record supporting the Regional Administrator's decision. Consistent with EPA's CWA Section 404(c) regulations at 40 CFR 231.6, the Assistant Administrator for Water provided the Parties with the opportunity to notify EPA of their intent to take corrective action to prevent unacceptable adverse effects on anadromous fishery areas from discharges of dredged or fill material associated with developing the Pebble deposit by December 19, 2022. A copy of EPA's December 2. 2022 letter can be found in Appendix A.

On December 12, 2022, ADNR responded to EPA's December 2, 2022 letter. In its December 12, 2022 letter, ADNR, joined by ADEC and ADF&G, expressed concern that EPA Region 10 initiated the CWA Section 404(c) action before ADF&G's Title 16 permitting process had begun, indicating that ADF&G could deny a state permit that would be required under Title 16 "should it determine that development

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[32] Information regarding the proposed determination can be found in the docket for this effort at www.regulations.gov, see docket ID No. EPA-R10-OW-2022-0418.

[33] Consistent with EPA's regulations, the USACE representative who received this notification was the Chief of Engineers.

of the Pebble Deposit will result in 'any adverse effect upon fish or wildlife, or their habitat' that cannot be appropriately mitigated."

ADNR also requested an in-person meeting. EPA agreed and on December 20, 2022, the Assistant Administrator for Water and EPA staff met with representatives from ADEC, ADNR, ADF&G, and the Alaska Attorney General's office. During the December 20, 2022 meeting, representatives from the State of Alaska shared a copy of ADEC's public comment letter on the proposed determination and a letter dated December 19, 2022. In its letter dated December 19, 2022, the State reiterated its contention that EPA's CWA Section 404(c) action would violate the ASA and the CILEA and included excerpts from the legislative history of the ASA in support of its assertions. As discussed previously, nothing in the ASA or the CILEA precludes the application of a duly enacted federal law, nor do those laws serve as a barrier to EPA's use of Section 404(c) of the CWA. Federal law, including the CWA, applies to lands and mineral deposits granted to the State just as it does elsewhere.

With respect to the State of Alaska's contentions regarding Title 16, EPA's authority to make CWA Section 404(c) determinations is not contingent upon any action by the State, including independent state permitting authorities. Moreover, EPA considered all of the mitigation measures the State identified during the FEIS process, both compensatory mitigation plans submitted by PLP during the CWA Section 404 permit review process (see Section 4.3.2), as well as all potential compensatory mitigation measures identified over the past decade by PLP and others (see Appendix C) before making its determination that the discharges of dredged or fill material evaluated in the final determination will result in unacceptable adverse effects on anadromous fishery areas in the SFK, NFK, and UTC watersheds. Accordingly, because the State did not identify any mitigation measures not previously considered by EPA, the State did not propose corrective action to prevent unacceptable adverse effects satisfactory to EPA (see 40 CFR 231.6).

During the December 20, 2022 meeting, representatives from the State of Alaska reiterated the same concerns that the State raised throughout the process, including in its public comments and its December 12 and December 19, 2022 letters. EPA considered the concerns raised by the State during the December 20, 2022 meeting before issuing this final determination. For more information about the State's comments and EPA's responses see EPA's Response to Comments (EPA 2023a). On December 19, 2022, PLP responded to EPA's December 2, 2022 letter. PLP's response reiterated comments provided previously to EPA, including its contentions that EPA's action is based on "speculative impacts," that EPA's action is overly broad and vague, that EPA has failed to consider compensatory mitigation, and that "corrective action is unnecessary." PLP did not propose corrective action to prevent unacceptable adverse effects satisfactory to EPA (see 40 CFR 231.6). For more information about PLP's comments and EPA's responses see EPA's Response to Comments (EPA 2023a).

USACE and Chuchuna Minerals responded on December 16, 2022, and December 19, 2022, respectively. Neither identified any corrective actions.

EPA's Office of Water continued the tribal consultation process initiated by EPA Region 10 for this CWA Section 404(c) action. The Assistant Administrator for Water engaged in multiple consultations with

tribal governments and Alaska Native Corporations in January 2023. A summary of EPA's tribal consultation process can be found in the docket for this effort at www.regulations.gov, see docket ID No. EPA-R10-OW-2022-0418.

2.2.3 Authority and Justification for Undertaking a Clean Water Act Section 404(c) Review at this Time

Congress provided EPA with broad authority to decide whether and when to use its CWA Section 404(c) authority. CWA Section 404(c) authorizes EPA to act "whenever" it makes the required determination under the statute. 33 USC 1344(c). EPA has, since at least 1979 when the Agency promulgated its CWA Section 404(c) regulations, construed CWA Section 404(c) to authorize the Agency to prohibit, withdraw, deny, or restrict the use of any defined area for specification as a disposal site for the discharge of dredged or fill material into waters of the United States before a permit application has been submitted, at any point during the permitting process, or after a permit has been issued.[34] 40 CFR 231.1(a), (c); 44 Fed. Reg. 58076 (Oct. 9, 1979). EPA's interpretation of the statute has been upheld by the courts. *See Mingo Logan Coal Co. v. EPA*, 714 F.3d 608, 613 (D.C. Cir. 2013). In *Mingo Logan Coal Co.*, the D.C. Circuit held that CWA Section 404(c) "imposes no temporal limits" on EPA's authority to limit USACE's ability to specify disposal sites "but instead expressly empowers [EPA] to prohibit, restrict or withdraw the specification 'whenever' [it] makes a determination that the statutory "unacceptable adverse effect" will result. *Id.* at 613. Importantly, the court noted that in "[u]sing the expansive conjunction 'whenever,' the Congress made plain its intent to grant [EPA] authority to prohibit/deny/restrict/withdraw a specification *at any time*.") *Id.* (emphasis added). The court further held that the language of CWA Section 404(c) is "unambiguous" and manifests Congress's intent to confer on EPA a broad power to exercise its authority under the subsection beyond the permit process. *Id.*

Similarly, EPA's authority applies broadly to "*any* defined area." 33 USC 1344(c) (emphasis added). The CWA does not define "defined area," nor stipulate a process for identifying a "defined area." Section 404 of the CWA does, however, distinguish between disposal sites that are specified by USACE and defined areas that are identified by EPA under CWA Section 404(c), indicating Congress's intent that "defined areas" identified by EPA under CWA Section 404(c) need not derive from or be limited by the USACE permitting process. [35] *See* 33 USC 1344 (a)-(c). Instead, the phrase "defined area" in CWA Section 404(c) "merely means that a 404(c) action must be directed at a particular or identifiable area rather than

[34] 40 CFR 231.1(a) provides, in relevant part, that "[u]nder section 404(c), [EPA] may exercise a veto over the specification by the U.S. Army Corps of Engineers or by a state of a site for the discharge of dredged or fill material. [EPA] may also prohibit the specification of a site under section 404(c) with regard to any existing or potential disposal site before a permit application has been submitted to or approved by the Corps or a state. [EPA] is authorized to prohibit or otherwise restrict a site whenever [it] determines that the discharge of dredged or fill material is having or will have an 'unacceptable adverse effect' on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas." 40 CFR 231.1(c) provides, in relevant part, that EPA's CWA Section 404(c) regulations "apply to all existing, proposed or potential disposal sites for discharges of dredged or fill material into waters of the United States."

[35] "USACE does not 'define' areas through the permit process; it 'specifies' them." 44 Fed. Reg. 58077 (Oct. 9, 1979).

'wetlands' or some other generic category." 44 Fed. Reg. 58077 (Oct. 9, 1979). In fact, the Ninth Circuit noted that "[b]oth the statute and the first steps in the regulations, 40 CFR 231.3(a), grant the agency unfettered discretion" and that EPA is "free to consider—or not—the suitability of invoking its Section 404(c) authority with respect to any given geographical area." *Trout Unlimited v. Pirzadeh*, 1 F.4th 738, 758 (9th Cir. 2021). It explained that "Congress provided that '[t]he Administrator is authorized' to restrict the specification 'of any defined area . . . as a disposal site, whenever he determines, after notice and opportunity for public hearings, that the discharge of such materials into such area will have an unacceptable adverse effect' on specified resources." *Id.* at 752. "And the number of 'any defined [geographical] area[s]' is limitless, suggesting that the agency retains discretion to choose among areas of infinite variation." *Id.*

Relationship to USACE Permitting Process. CWA Section 404(c) provides EPA with independent authority, separate and apart from the USACE CWA Section 404 permitting process, to review and evaluate potential discharges of dredged or fill material into waters of the United States. While the statutory language in CWA Section 404(b) expressly makes USACE's authority "subject to subsection (c)," there is no comparable text in CWA Section 404(c) that constrains EPA's authority. The statute and EPA's CWA Section 404(c) implementing regulations provide USACE with a consultation role when EPA uses its CWA Section 404(c) authority. Furthermore, EPA's determination of unacceptable adverse effects under CWA Section 404(c) is not coterminous with the requirements that apply to USACE's permitting decisions.

Nothing in the CWA or EPA's CWA Section 404(c) regulations precludes EPA from exercising its authority where USACE has denied a permit. Although EPA's 1979 preamble to the CWA Section 404(c) regulations recognized that EPA may choose not to exercise its authority in instances "where the Regional Administrator also has reason to believe that [the] permitting authority will deny the permit" because "a 404(c) proceeding would be unnecessary," that was a statement of policy affirming EPA's discretion to decide whether or not to initiate a CWA Section 404(c) review process rather than an indication of a limitation on EPA's authority. 44 Fed. Reg. 58079 (Oct. 9, 1979). Moreover, in this instance, PLP filed an administrative appeal of USACE's CWA Section 404 permit denial on January 19, 2021. USACE's review of PLP's appeal is ongoing. Because EPA's use of its CWA Section 404(c) authority is independent from USACE's timing and actions related to a permit denial, by acting now EPA's action facilitates regulatory certainty regardless of the outcome of the permit denial appeal process and any subsequent litigation challenging a USACE final permitting decision. Furthermore, EPA has determined that each of the impacts on aquatic resources identified in Sections 4.2.1 through 4.2.4 independently will have unacceptable adverse effects. EPA's determination is therefore distinguishable from USACE's findings, and ultimately its permit denial, because, among other things, USACE reached its conclusions based on consideration of the impacts on aquatic resources identified in Sections 4.2.1 through 4.2.4 collectively rather than independently.[36]

[36] USACE's denial of PLP's permit application only addresses the 2020 Mine Plan and does not address any other potential proposal to develop the Pebble deposit.

Relationship between CWA Section 404(c) and CWA Section 404(q) Process. EPA's CWA Section 404(c) regulations authorize the Regional Administrator to initiate the CWA Section 404(c) process "after evaluating the information available to him, including any record developed under the section 404 referral process." 40 CFR 231.3(a). EPA's regulations include a comment, which states that "[i]n cases involving a proposed disposal site for which a permit application is pending, it is anticipated that the procedures of the section 404 referral process will normally be exhausted prior to any final decision of whether to initiate a 404(c) proceeding." *See comment* at 40 CFR 231.3(a)(2). EPA has explained that the reference to the "404 referral process" in the regulations is now manifested as the coordination processes EPA and USACE have established under CWA Section 404(q). 84 Fed. Reg. 45749, 45752 (August 30, 2019); *see* EPA and DA 1992.[37]

The stated purpose of the CWA Section 404(q) MOA coordination procedures is to "provide and encourage communication and full consideration of each agencies' views concerning proposed projects within the resource limits of each agency and the time constraints of the regulatory process." (EPA and DA 1992: Part II, Paragraph 1). As an initial matter, the CWA Section 404(q) MOA explicitly recognizes that it does not constrain EPA's statutory authority under CWA Section 404(c): "[t]his agreement does not diminish either Army's authority to decide whether a particular individual permit should be granted, including determining whether the project is in compliance with the Section 404(b)(1) Guidelines, or the Administrator's authority under Section 404(c) of the Clean Water Act." (EPA and DA 1992: Part I, paragraph 5). Nothing in the statute or EPA's regulations restricts EPA to considering information or concerns raised during the CWA Section 404(q) elevation process, if any. All that is required is that EPA consider any information generated during the CWA Section 404(q) MOA interagency coordination process, if applicable. Moreover, as discussed below, EPA coordinated extensively with USACE throughout the permitting process for the proposed 2020 Mine Plan and considered the information raised. Thus, EPA has satisfied the purpose of the CWA Section 404(q) coordination procedures.

EPA Policy and Precedent Regarding Use of Its CWA Section 404(c) Authority. EPA has used its CWA Section 404(c) authority judiciously, including in instances before a permit application has been submitted, at various stages during the permitting process, and after permit issuance. Prior to this final determination, EPA had initiated the process 30 times and only issued 13 final determinations in the 50 years since Congress enacted CWA Section 404(c). Each instance where EPA initiated a CWA Section 404(c) process has involved EPA's case-by-case determination of when and how to exercise its CWA Section 404(c) authority based on the specific facts of each situation consistent with applicable statutory and regulatory requirements. EPA's 1979 preamble to the CWA Section 404(c) regulations includes statements describing EPA's general policy intentions regarding the use of its CWA Section 404(c) authority. It states the following:

> EPA's announcement of intent to start a 404(c) action will ordinarily be preceded by an objection to the permit application, and under § 325.8 such objection serves to halt issuance of the permit until the matter is resolved. . . . The promulgation of regulations under 404(c) will not alter EPA's present obligations to make timely objections to permit applications

[37] See footnote 28 in Section 2.

> where appropriate. It is not the Agency's intention to hold back and then suddenly to spring a veto action at the last minute. The fact that 404(c) may be regarded as a tool of last resort implies that EPA will first employ its tool of 'first resort,' e.g., comment and consultation with the permitting authority at all appropriate stages of the permit process.
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> 44 Fed. Reg. 58080 (Oct. 9, 1979).

The clear intention behind this policy is that EPA voice any concerns it has throughout the process. EPA has done that here, as summarized below.

EPA's actions throughout the proposed Pebble Mine project history, including during the USACE permitting process, are consistent with the policy articulated in the 1979 preamble. EPA employed its tools of first resort, including comment and coordination with USACE during the permitting process. EPA also initiated the CWA Section 404(q) process by providing USACE a CWA Section 404 "3a" letter on July 1, 2019 out of concern regarding "the extent and magnitude of the substantial proposed impacts to streams, wetlands, and other aquatic resources that may result, particularly in light of the important role these resources play in supporting the region's valuable fishery resources" (EPA 2019a: Page 3). As part of the CWA Section 404(q) MOA dispute resolution process, EPA engaged in 12 weeks of coordination with USACE—from March 2020 through May 2020—to evaluate the 2020 Mine Plan for compliance with the CWA Section 404(b)(1) Guidelines. On May 28, 2020, EPA sent a letter to USACE that had the effect of discontinuing the formal CWA Section 404(q) MOA dispute resolution process. In its May 28, 2020 letter, EPA explained that "[USACE] has demonstrated its commitment to the spirit of the dispute resolution process pursuant to the 1992 Memorandum of Agreement between EPA and the Department of the Army regarding CWA Section 404(q) by the extensive engagement with the EPA over the recent months" and its "recent commitment to continue this coordination into the future, outside of the formal dispute process." EPA's letter recognized that although there was not a need at that time for a formal dispute process, substantive discussions among USACE, EPA, and USFWS regarding compliance with the Guidelines were ongoing and the agencies were continuing to discuss and raise concerns (EPA 2020).

Timing of EPA's Action. As discussed above, Congress enacted CWA Section 404(c) to provide EPA the ultimate authority, if it chooses on a case-by-case basis, to prohibit, withdraw, deny, or restrict the use of any defined area for specification as a disposal site for the discharge of dredged or fill material into waters of the United States "whenever" the Agency makes the required determination under the statute. 33 USC 1344(c); 40 CFR 231.1 (a), (c); 44 Fed. Reg. 58076 (Oct. 9, 1979); *Mingo Logan Coal Co.*, 714 F.3d at 612-13. EPA has reviewed the available information,[38] including the relevant portions of the USACE permitting record, and this information supports EPA's determinations that the discharges of dredged

[38] 40 CFR 231.1(a) provides, in relevant part, that in making its determination that discharges of dredged or fill "[are] having or will have an 'unacceptable adverse effect' on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas," EPA "will take into account all information available to [it], including any written determination of compliance with the section 404(b)(1) Guidelines made in 40 CFR Part 230." The available information includes, among other things, pre-CWA Section 404 permit application and advance NEPA coordination meetings beginning in 2004; NDM's preliminary mine plans submitted to the SEC (Ghaffari et al. 2011, SEC 2011); PLP's initial and supplemental Environmental Baseline Documents (PLP 2011, PLP 2018a); EPA's BBA (EPA 2014); PLP's CWA Section 404 permit application (PLP 2017, PLP 2020b); and USACE's FEIS and ROD regarding PLP's permit application (USACE 2020a, USACE 2020b).

or fill material evaluated in this final determination will have unacceptable adverse effects on anadromous fishery areas in the SFK, NFK, and UTC watersheds.

By acting now, EPA makes clear its assessment of the effects of certain discharges of dredged or fill material associated with developing the Pebble deposit into certain waters of the United States within the SFK, NFK, and UTC watersheds in light of the significant loss of and damage to important anadromous fishery areas. The federal government, the State of Alaska, federally recognized tribal governments, PLP, and many other interested stakeholders have devoted significant resources over many years of study, engagement, and review. Considering the extensive record, it is not efficient or effective to engage in one or more additional multi-year NEPA or CWA Section 404 processes for future proposals to discharge dredged or fill material associated with developing the Pebble deposit into waters of the United States within the SFK, NFK, or UTC watersheds that will result in adverse effects that EPA has already determined are unacceptable. By acting now, based on an extensive and carefully considered record, EPA promotes regulatory certainty for all stakeholders, including USACE and the regulated community; facilitates planning by proponents; and avoids unnecessary expenditure of additional resources by all interested parties. *See* 44 FR 58077.[39] Ultimately, by acting now, EPA also facilitates "comprehensive rather than piecemeal protection" of important aquatic resources, *see id.*, by ensuring the protection of valuable anadromous fishery areas in the SFK, NFK, and UTC watersheds against unacceptable adverse effects from the discharges evaluated in this final determination.

[39] EPA explicitly acknowledged in the preamble to its 1979 CWA Section 404(c) regulations that among other strong reasons to exercise its CWA Section 404(c) authority pre-permit was "eliminating frustrating situations in which a proponent spends time and money developing a project for an inappropriate site . . . ." 44 Fed. Reg. 58077 (Oct. 9, 1979).

SECTION 3. IMPORTANCE OF THE REGION'S ECOLOGICAL RESOURCES

The Bristol Bay watershed represents a largely pristine, intact ecosystem with outstanding ecological resources. It is home to at least 29 fish species, more than 40 terrestrial mammal species, and more than 190 bird species (Woody 2018). This ecological wealth supports a number of sustainable economies that are of vital importance to the region, including subsistence, commercial, and sport fishing; subsistence and sport hunting; and non-consumptive recreation. The undisturbed habitats of the Bristol Bay watershed support one of the last salmon-based cultures in the world (EPA 2014: Appendix D), and the subsistence way of life in this region is irreplaceable. Between 2013 and 2019, the annual economic output generated by Bristol Bay's wild salmon resources was estimated at more than $1 billion (Wink Research and Consulting 2018, McKinley Research Group 2021), with total economic value (including subsistence uses) estimated at more than $2 billion in 2019 (McKinley Research Group 2021).

The following sections consider the Bristol Bay watershed's ecological resources, with particular focus on the region's fish habitats and populations and the watershed characteristics that support these resources. Given the connected and spatially nested structure of watersheds (EPA 2015), the migratory nature of many of the region's fish populations, and the importance of evaluating fish-habitat relationships across spatial scales (Bryant and Woodsmith 2009, Jackson and Fahrig 2015, Hale et al. 2019), these ecological resources are considered at multiple geographic scales.

The Pebble deposit is located in the Bristol Bay watershed, in the headwaters of tributaries to both the Nushagak and Kvichak Rivers. The three tributaries that originate within the Pebble deposit are the SFK, which drains the western part of the Pebble deposit area and converges with the NFK west of the Pebble deposit; the NFK, located immediately west of the Pebble deposit; and UTC, which drains the eastern portion of the Pebble deposit and flows into the Kvichak River via Iliamna Lake.[40] The SFK, NFK, and UTC watersheds are the areas that would be most directly affected by mine development at the Pebble deposit, as well as the watersheds within which the most extensive physical, chemical, and biological data have been collected to date (e.g., PLP 2011, PLP 2018a, USACE 2020a). Streams and wetlands in each of the SFK, NFK, and UTC watersheds provide habitat for five species of Pacific salmon and numerous other fish species. Each of these headwater watersheds also supports fish habitats and populations in larger downstream systems via contributions of water, organisms, organic matter, and other resources.

[40] The SFK comprises two 12-digit hydrologic unit codes (HUCs): the Headwaters Koktuli River (190303021101) and the Upper Koktuli River (109303021102). The NFK comprises two 12-digit HUCs: Groundhog Mountain (190303021103) and one 12-digit HUC located immediately west of the Pebble deposit (190303021104). UTC represents one 10-digit HUC (1903020607).

3.1 Physical Setting

Bristol Bay is a large gulf of the eastern Bering Sea in southwestern Alaska. The land area draining to Bristol Bay consists of six major watersheds—from west to east, the Togiak, Nushagak, Kvichak (including the Alagnak), Naknek, Egegik, and Ugashik River watersheds—and a series of smaller watersheds draining northward along the Alaska Peninsula (Figure ES-1). The Pebble deposit is located in the headwaters of tributaries to both the Nushagak and Kvichak Rivers; together, the watersheds of the Nushagak and Kvichak Rivers account for approximately half of the land area in the Bristol Bay watershed (USACE 2020a: Section 3.24).

Detailed information on the Bristol Bay watershed's physical setting, in terms of physiography, hydrologic landscapes, and seismicity, can be found in Chapter 3 of the BBA (EPA 2014). One component of the watershed's physical setting, however, is particularly important to note: the watersheds draining to Bristol Bay provide intact, connected, and free-flowing habitats from headwaters to ocean. Long, free-flowing rivers are globally rare (Grill et al. 2019). Unlike most other areas supporting Pacific salmon populations in North America, the Bristol Bay watershed is undisturbed by significant human development and impacts. It is located in one of the last remaining virtually roadless areas in the United States (EPA 2014: Chapter 6). Large-scale, human-caused modification of the landscape—a factor contributing to extinction risk for many native salmonid populations (Nehlsen et al. 1991)—is absent, and development in the watershed consists of only a small number of towns, villages, and roads. The Bristol Bay watershed also encompasses Iliamna Lake, the largest lake in Alaska and the largest undeveloped lake in the United States. As a result, the structure and function of aquatic habitats in the Bristol Bay watershed are characteristic of habitats in minimally altered landscapes.

The primary human manipulation of the Bristol Bay ecosystem is the marine harvest of roughly 50 to 70 percent of salmon returning to spawn (Kendall et al. 2009, EPA 2014: Chapter 5). Management of Alaska's salmon fisheries is geared toward maintenance of a sustainable fishery through protection of its wild salmon populations, or stocks (5 AAC 39.200, 5 AAC 39.220, 5 AAC 39.222, 5 AAC 39.223). A key goal of ADF&G's policy for the management of sustainable salmon fisheries is "to ensure conservation of salmon and salmon's required marine and aquatic habitats" (5 AAC 39.222), highlighting the importance of maintaining sustainable salmon-based ecosystems. Fishery management in Bristol Bay is unique in part because no hatchery fishes are reared or released in the watershed, whereas approximately 5 billion hatchery-reared juvenile Pacific salmon are released annually across the North Pacific (Irvine et al. 2012). This lack of hatchery fishes in the Bristol Bay region is notable, given the economic investment that rearing and releasing hatchery fishes requires and the fact that its benefits are highly variable and difficult to quantify (Naish et al. 2008). Hatchery fishes also can have significant adverse effects on wild fish populations (e.g., Levin et al. 2001, Araki et al. 2009, Rand et al. 2012, Evenson et al. 2018, Tillotson et al. 2019).

3.2 Aquatic Habitats

The Bristol Bay region encompasses complex combinations of physiography, climate, geology, and hydrology, which interact to control the amount, distribution, and movement of water through a landscape shaped by processes such as tectonic uplift, glaciation, and fluvial erosion and deposition. Ultimately, these factors result in a landscape marked by abundant, diverse freshwater habitats. These diverse habitats, in conjunction with the enhanced ecosystem productivity associated with anadromous salmon runs, support a high level of biological complexity (biocomplexity) that contributes to the environmental integrity and resilience of the Bristol Bay watershed's ecosystems (Section 3.3.3) (Schindler et al. 2010, Ruff et al. 2011, Lisi et al. 2013, Schindler et al. 2018, Brennan et al. 2019).

This section presents key aspects of the region's aquatic habitats, in terms of characteristics that contribute to their quality and diversity, the quantity and types of streams and wetlands found in the region, and their importance in the larger landscape. Together, these spatially and temporally variable aquatic habitats create the dynamic freshwater ecosystem mosaic (Mushet et al. 2019) critical to maintaining the region's exceptional salmon populations, as well as other fish and wildlife populations. According to the Anadromous Waters Catalog (ADF&G 2022c), fish habitat is "any area on which fish depend, directly or indirectly, during any stage of their life cycle." For salmon, this includes spawning habitats, where adults deposit and fertilize eggs; rearing habitats, where fertilized eggs incubate and juveniles feed, grow, and overwinter as they develop into adults; and migratory habitats, through which juveniles and adults predictably and purposefully move to complete their life cycles (ADF&G 2022c). Habitat needs vary with season and salmon life stage (Bjornn and Reiser 1991), and events occurring during one life stage continue to influence both individuals and populations in later life stages (Marra et al. 2015). As a result, continued productivity of the region's salmon populations depends on diverse, high-quality, and proximally located aquatic habitats that support all freshwater salmon life stages.

3.2.1 Quantity and Diversity of Aquatic Habitats

In general, conditions in the Bristol Bay watershed are highly favorable for Pacific salmon. The region encompasses an abundant and diverse array of aquatic habitats (Section 3.2) that in turn support a diverse salmonid assemblage (Section 3.3). Together, these factors result in high degrees of phenotypic and genotypic diversity across the region's salmon populations. This biocomplexity produces the asynchronous dynamics that stabilize the overall portfolio of salmon returns to the region (Section 3.3.3).

In the Nushagak and Kvichak River watersheds, freshwater habitats range from headwater streams to braided rivers, small ponds to large lakes, and side channels to off-channel alcoves. Overall physical habitat complexity is higher in the Bristol Bay watershed than in many other systems supporting Sockeye Salmon populations. Of 1,509 North Pacific Rim watersheds, the Kvichak, Wood, and Nushagak (exclusive of Wood) Rivers (Figure ES-2) ranked third, fourth, and forty-fourth, respectively, in physical habitat complexity, based on an index including variables such as lake coverage, stream junction density, floodplain elevation and density, and human footprint (Luck et al. 2010, RAP 2011).

Lakes and associated tributary and outlet streams are key spawning and rearing areas for Sockeye Salmon. Lakes cover relatively high percentages of watershed area in the Bristol Bay region, with 7.9 percent lake cover for the Bristol Bay watershed and 13.7 percent lake cover for the Kvichak River watershed within the larger Bristol Bay watershed (RAP 2011). In other North Pacific river systems supporting Sockeye Salmon populations, from northern Russia to western North America, these values tend to be much lower (0.2 to 2.9 percent) (RAP 2011). Relatively low watershed elevations and the absence of artificial barriers to migration (e.g., dams and roads) mean that not only are streams, lakes, and other aquatic habitats abundant in the Bristol Bay region, but they also tend to be accessible to anadromous salmonids (EPA 2014: Appendix A).

Gravel is an essential substrate for salmon spawning and egg incubation (Bjornn and Reiser 1991, Quinn 2018). Specific substrate and hydraulic requirements vary slightly by species (EPA 2014: Appendix A), but stream-spawning salmon generally require relatively clean gravel-sized substrates with interstitial flow, and sufficient bed stability to allow eggs to incubate in place for months prior to fry emergence (Quinn 2018). In the Bristol Bay watershed, gravel substrates are abundant (EPA 2014: Chapter 7). The Pebble deposit area is heavily influenced by past glaciation (PLP 2011: Chapter 3), and unconsolidated glacial deposits cover most of the area's lower elevations (Detterman and Reed 1973). As a result, the SFK, NFK, and UTC stream valleys have extensive glacial sand and gravel deposits (PLP 2011: Chapter 8).

A key aspect of the Bristol Bay watershed's aquatic habitats is the importance of groundwater exchange. Because salmon rely on clean, cold water flowing over and upwelling and downwelling through porous gravel for spawning, egg incubation, and rearing (Bjornn and Reiser 1991), areas of groundwater exchange create high-quality salmon habitat (EPA 2014: Appendix A). For example, densities of beach-spawning Sockeye Salmon in the Wood River watershed (within the larger Nushagak River watershed) were highest at sites with strong groundwater upwelling and zero at sites with no upwelling (Burgner 1991). Significant portions of the Nushagak and Kvichak River watersheds, including the Pebble deposit area, contain coarse-textured glacial drift with abundant, high-permeability gravels and extensive connectivity between surface waters and groundwater (EPA 2014: Chapter 3).

Groundwater is the source of baseflow in most streams draining the Pebble deposit area (Rains 2011, USACE 2020a: Section 3.17). Groundwater contributions to streamflow, along with the influence of run-of-the-river lakes, support flows in the region's streams and rivers that are more stable than those typically observed in many other salmon streams (e.g., in the Pacific Northwest or southeastern Alaska). This results in more moderated streamflow regimes with lower peak flows and higher baseflows, creating a less temporally variable hydraulic environment (EPA 2014: Figure 3-10). Interactions between surface waters and groundwater in the SFK, NFK, and UTC watersheds are complex and depend on factors such as local soil type and land and water table gradients. These watersheds include reaches that gain water from groundwater and reaches that lose water to groundwater, with hyporheic flows occurring at very local scales (USACE 2020a: Section 3.17).

This groundwater–surface water connectivity also has a strong influence on stream thermal regimes in the Nushagak and Kvichak River watersheds, providing a moderating influence against both summer heat and winter cold extremes. Average monthly stream water temperatures in the Pebble deposit area in July or August can range from 6°C to 16°C, and temperatures do not uniformly increase with decreasing elevation (PLP 2011: Appendix 15.1E, Attachment 1). This spatial variability in temperatures in the Pebble deposit area is consistent with streams influenced by a variety of thermal modifiers, including groundwater inputs, upstream lakes, and tributary contributions (Mellina et al. 2002, Armstrong et al. 2010). Longitudinal temperature profiles from August and October indicate that the mainstem SFK and NFK reaches just downstream of the tributaries draining the potential mine area experience significant summer cooling and winter warming compared to adjacent upstream reaches (PLP 2011: Chapter 9), suggesting significant groundwater contributions. Consistent winter observations of ice-free conditions in the area's streams also suggest the presence of upwelling groundwater in strongly gaining reaches of the SFK, NFK, and UTC (PLP 2011: Chapter 7, Woody and Higman 2011). Areas of groundwater downwelling are also important to fish and aquatic species and are documented to occur in the SFK, NFK, and UTC watersheds (USACE 2020a: Section 3.17).

These groundwater–surface water interactions and their influence on water temperature are extremely important for fishes, particularly salmon. Water temperature controls the metabolism and behavior of salmon and, if temperatures are stressful, fishes can be more vulnerable to disease, competition, predation, or death (McCullough et al. 2009). The State of Alaska has maximum temperature limits for salmon migration routes, spawning and rearing areas, and fry incubation areas (ADEC 2020). However, summer is not the only period of temperature sensitivity for salmon (Poole et al. 2004). For example, small temperature changes during salmon egg incubation in gravels can alter the timing of emergence by months (Brannon 1987, Beacham and Murray 1990, Quinn 2018). Groundwater moderates winter temperatures, which strongly control egg development, egg hatching, and emergence timing (Brannon 1987, Hendry et al. 1998). Groundwater contributions that maintain water temperatures above 0^{0}C are critical for maintaining winter refugia in streams that might otherwise freeze (Power et al. 1999). Thus, winter groundwater connectivity may be critical for fishes in such streams (Cunjak 1996, Huusko et al. 2007, Brown et al. 2011).

Since the timing of migration, spawning, and incubation are closely tied to seasonal water temperatures, groundwater-influenced thermal heterogeneity can also facilitate diversity in run timing and other salmon life-history traits (Hodgson and Quinn 2002, Rogers and Schindler 2011, Ruff et al. 2011). Any thermal regime alterations resulting from changes in groundwater–surface water connectivity could disrupt life-history timing cues and result in mismatches between fishes and their environments that adversely affect survival (Angilletta et al. 2008).

In terms of water quality, streams draining the Pebble deposit area tend to have near-neutral pH, with low conductivity, alkalinity, dissolved solids, suspended solids, and dissolved organic carbon (USACE 2020a: Section 3.18). In these respects, they are characteristic of undisturbed streams. However, as would be expected for a metalliferous site, levels of sulfate and some metals (copper, molybdenum, nickel, and zinc) are elevated, particularly in the SFK. Copper levels in approximately 40 percent of

samples from the SFK exceeded Alaska's chronic water quality standard (USACE 2020a: Section 3.18). However, most exceedances were in or close to the deposit area, and the number and magnitude of exceedances decreased with distance downstream (USACE 2020a: Appendix K3.18).

In summary, the Bristol Bay watershed in general, and the SFK, NFK, and UTC watersheds specifically, provide diverse and productive habitat for salmon and other fishes. Suitable substrates for salmon spawning, egg incubation, and rearing are abundant. Extensive connectivity between groundwater and surface waters creates and maintains a variety of streamflow and thermal regimes across the region, resulting in favorable spawning and rearing habitats for salmonids and helping to support diverse fish assemblages.

3.2.2 Streams

The Nushagak and Kvichak River watersheds contain over 33,000 miles (54,000 km) of streams, approximately 667 miles (1,085 km) of which are in the SFK, NFK, and UTC watersheds. The stream and river habitats of the SFK, NFK, and UTC watersheds can be characterized in terms of attributes that generally represent fundamental aspects of the physical and geomorphic settings in streams. Evaluation of stream and river habitats within the SFK, NFK, and UTC watersheds based on these attributes provides important context for how these streams and rivers contribute to fish habitats (Burnett et al. 2007, Shallin Busch et al. 2013). EPA (2014) describes stream and river valley attributes for each of the 52,277 stream and river reaches in the Nushagak and Kvichak River watersheds documented in the National Hydrography Dataset (NHD) (USGS 2012).[41] Three key attributes were estimated for each reach: mean channel gradient, mean annual streamflow, and percentage of flatland in the contributing watershed lowland (EPA 2014: Chapters 3 and 7). Stream reaches were then categorized according to each attribute to evaluate the relative suitability of these reaches as fish habitat.[42]

Because conditions at salmon spawning sites play a large role in determining the survival of eggs and rearing alevins, the geomorphic and hydrologic conditions at spawning sites are key determinants of population success (Beechie et al. 2008, Gibbins et al. 2008). Results of the stream reach classification show that a high proportion of stream channels in the SFK, NFK, and UTC watersheds possess the broad geomorphic and hydrologic characteristics that create stream and river habitats highly suitable for fishes such as Pacific salmon, Rainbow Trout, and Dolly Varden: low stream gradients, mean annual streamflows greater than or equal to 5.3 ft^3/s (0.15 m^3/s), and at least 5 percent flatland in lowland (an indicator of the potential for floodplain development) (EPA 2014: Chapter 7).

The substrate and hydraulic conditions required by stream-spawning salmon are most often met in stream channels with gradients less than 3 percent (Montgomery et al. 1999). Pool-riffle channels have moderate slopes (<1.5 to 2 percent) and are indicative of quality spawning habitat (Miller et al. 2008,

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[41] Analysis is based on the 2012 iteration of the NHD (USGS 2012); total mapped stream length in the SFK, NFK, and UTC watersheds changed by only 1 percent between the 2012 and 2021 iterations of the NHD.

[42] EPA (2014: Chapters 3 and 7) provides a detailed discussion of the importance of each attribute in determining fish habitat and the method used to categorize each attribute.

Buffington et al. 2004). At gradients above 3 percent, the size, stability, and frequency of patches of suitable spawning substrates are substantially reduced (Montgomery and Buffington 1997). In the SFK, NFK, and UTC watersheds, low-gradient (<3 percent) channels account for 87 percent of the stream network, highlighting the availability of quality salmon spawning habitat in this region (Table 3-1).

Table 3-1. Distribution of stream channel length classified by channel size (based on mean annual streamflow), channel gradient, and floodplain potential for streams and rivers in the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek watersheds. See EPA (2014) Chapters 3 and 7 for additional details on the methods used to classify stream channels. [a]

Channel Size	Gradient							
	<1%		≥1% and <3%		≥3% and <8%		≥8%	
	FP [b]	NFP [b]	FP [b]	NFP [b]	FP [b]	NFP [b]	FP [b]	NFP [b]
Small headwater streams [c]	15%	5%	5%	28%	0%	12%	0%	0%
Medium streams [d]	14%	6%	0%	3%	0%	1%	0%	0%
Small rivers [e]	8%	2%	0%	1%	0%	0%	0%	0%
Large rivers [f]	0%	0%	0%	0%	0%	0%	0%	0%

Notes:

[a] Analysis is based on 2012 iteration of the NHD (USGS 2012); total mapped stream length in the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek watersheds changed by only 1 percent between 2012 and 2021 iterations of the NHD.

[b] FP = high floodplain potential (greater than or equal to 5 percent of flatland in lowland); NFP = no or low floodplain potential (less than 5 percent of flatland in lowland).

[c] 0–5.3 ft^3/s (0–0.15 m^3/s); most tributaries in the mine footprints defined in the BBA (EPA 2014: Chapter 6).

[d] 5.3–100 ft^3/s (0.15–2.8 m^3/s); upper reaches and larger tributaries of the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek.

[e] 100–1000 ft^3/s (2.8–28 m^3/s); middle to lower portions of the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek, including mainstem Koktuli River.

[f] >1000 ft^3/s (>28 m^3/s); the Mulchatna River below the Koktuli River confluence, the Newhalen River, and other large rivers. Note that there are no large rivers in the SFK, NFK, and UTC watersheds.

Mean annual streamflow is a metric of stream size. Pacific salmon in the Bristol Bay region use a wide range of river and stream sizes for migration, spawning, and/or rearing habitat, but low-gradient streams of medium size (5.3 to 100 ft^3/s [0.15 to 2.8 m^3/s] mean annual streamflow) or greater likely provide high-capacity, high-quality habitats for salmonids (EPA 2014: Chapter 7). Such streams and rivers account for 34 percent of the stream network in the SFK, NFK, and UTC watersheds (Table 3-1). However, salmonid species differ in their propensities for small streams. Dolly Varden have been documented using all stream sizes, including some of the smallest channels. Of the Pacific salmon species, Coho Salmon are most likely to use small streams for spawning and rearing and have been observed in many of the smaller streams near the Pebble deposit (Woody and O'Neal 2010). Larger-bodied Chinook Salmon adults are less likely to access smaller streams for spawning (Quinn 2018), although each year 12 to 21 percent of radio-tagged Chinook Salmon in the Togiak River watershed (located southwest of the Nushagak River watershed) spawned in smaller order tributaries (Sethi and Tanner 2014). Juvenile Chinook Salmon also have been observed in small tributaries where spawning has not been documented (Bradford et al. 2001, Daum and Flannery 2011, Phillis et al. 2018), including in smaller streams near the Pebble deposit. In the SFK, NFK, and UTC watersheds, small streams account for 65 percent of the stream network (Table 3-1).

Streams in the larger valleys of the SFK, NFK, and UTC watersheds tend to have extensive flat floodplains or terraces (Table 3-1). These unconstrained channels generally have higher complexity of channel

habitat types and hydraulic conditions and higher frequencies of off-channel habitats such as side channels, sloughs, and beaver ponds. Such habitat complexity can be beneficial to salmon by providing diverse spawning and rearing habitats throughout the year (Stanford et al. 2005). For Coho and Chinook salmon, as well as river-rearing Sockeye Salmon that may overwinter in streams, such habitats may be particularly valuable by providing unique thermal, foraging, and growth advantages not available to juveniles in the main channel (Bradford et al. 2001, Huntsman and Falke 2019). In addition, smaller, steeper streams in the watersheds provide both seasonal (and some year-round) habitat for other fish species and important nutrient supply to downstream waters (Section 3.2.4).

3.2.3 Wetlands, Lakes, and Ponds

A thorough inventory of wetland, lake, and pond habitats within the Bristol Bay watershed, or even the Nushagak and Kvichak River watersheds, has not been completed. However, the National Wetlands Inventory (NWI) (USFWS 2021) includes data for approximately 96 percent of the area encompassed by the SFK, NFK, and UTC watersheds (Table 3-2). Wetlands comprise roughly 18 percent of the combined area of the three watersheds, with similar wetland types and proportions found in each watershed (Table 3-2; Box 3-1).

Table 3-2. Acreage of wetland habitats in the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek watersheds. Number in parentheses indicates percent of wetland or wetland type relative to total area in the watershed.

Wetland Type	Description	SFK	NFK	UTC	Total [a]
Freshwater emergent wetland	Non-tidal wetlands dominated by erect, rooted herbaceous hydrophytes	3,116 (4)	3,532 (5)	4,580 (5)	11,228 (5)
Freshwater forested/scrub-shrub wetland	Non-tidal wetlands dominated by either trees greater than 20 feet in height (forested) or shrubs and tree saplings less than 20 feet in height (scrub-shrub)	5,693 (8)	12,220 (18) [b]	6,194 (7)	24,107 (11)
Freshwater pond	Non-tidal wetlands and shallow water (less than 6.6 feet deep) habitats that are at least 20 acres in size, have either less than 30 percent vegetative cover or a plant community dominated by species that principally grow on or below water surface, and have at least 25 percent of substrates less than 2.75 inches in size	931 (1)	1,397 (2)	1,090 (1)	3,418 (1)
Lake	Wetlands and deep-water (deeper than 6.6 feet) habitats that are situated in topographic depressions, have less than 30 percent vegetative cover, and are greater than 20 acres in size	611 (1)	427 (1)	698 (1)	1,737 (1)
Riverine	Wetlands and deep-water (deeper than 6.6 feet) habitats in natural or artificial channels that contain flowing water at least periodically	507 (1)	480 (1)	632 (1)	1,619 (1)
TOTAL WETLAND AREA		**10,859 (15)**	**18,056 (26)**	**13,194 (15)**	**42,109 (18)**
TOTAL WATERSHED AREA		**71,492**	**69,612**	**87,547**	**228,651**

Notes:

[a] Approximately 96 percent of the area within these watersheds has National Wetlands Inventory (NWI) coverage; the 4 percent of the area without coverage is located in lower elevation areas of the Upper Talarik Creek watershed. Note that individual percentages may not exactly add to total percentages within and across watersheds due to rounding.

[b] The data presented in NWI for the western portion of the NFK watershed are an "interim scalable map product" (USFWS 2022a) that "is considered preliminary and is a compilation of existing data and limited aerial image interpretation rather than an image-based mapping process" (USFWS 2022b). These preliminary, interim data appear to overestimate the freshwater forested/scrub-shrub wetlands in portions of the NFK watershed compared to the adjacent areas completed using image-based mapping processes.

Source: USFWS 2021.

BOX 3-1. SIMILARITY OF AQUATIC RESOURCES WITHIN THE SOUTH FORK KOKTULI RIVER, NORTH FORK KOKTULI RIVER, AND UPPER TALARIK CREEK WATERSHEDS

Throughout most of Section 3, the SFK, NFK, and UTC watersheds are discussed in combination because of the broad similarity of aquatic resources across the three watersheds. Each watershed is unique, but they share a roughly similar size, a headwater location, and numerous similarities in terms of the types and distribution of aquatic habitats, their physical and chemical characteristics, and their use by fish populations. Specific examples of these similarities are provided below.

Types and distribution of aquatic habitats

- The SFK, NFK, and UTC watersheds have similar lengths of total stream miles (relative to their watershed areas) and similar percentages of total stream miles documented to support anadromous fishes (29–31 percent in each watershed) (Table 3-6).
- Headwaters of all three watersheds contain dense first-order tributary networks that contribute subsidies of flow, energy, and organic matter to downstream reaches (USACE 2020a: Page 3.24-3).
- Each watershed contains multiple lakes, ponds, and wetlands that provide fish habitat and support downstream flows (USACE 2020a: Pages 3.16-8 and 3.24-3); similar amounts and types of wetlands are found in all three watersheds (Table 3-2).
- Floodplain and off-channel habitats, including beaver ponds, are important habitat components in all three watersheds (USACE 2020a: Table 3-24-3).

Physical and chemical characteristics of the watersheds and their aquatic habitats

- Headwaters of the SFK, NFK, and UTC watersheds have similar terrain and elevation (USACE 2020a: Table 3.16-1). All three watersheds transition to lower-gradient streams as one moves from headwaters to downstream areas, and lower stream reaches are similar in terms of gradient and substrate type (USACE 2020a: Table 3.24-2).
- Water temperature and water chemistry parameters are similar across the SFK, NFK, and UTC watersheds (USACE 2020a: Tables K3.18-7–K3.18-9).
- The SFK, NFK, and UTC have similar mean annual streamflows (relative to their watershed areas), as well as similar seasonal discharge patterns, with high streamflows in spring and fall and low streamflows in winter and mid-summer (USACE 2020a: Page 3.16-8, Table K3.16-3).
- Interactions between surface waters and groundwaters are a key component of the aquatic habitats in all three watersheds. Groundwater seeps are common in the headwaters of the three watersheds (USACE 2020a: Figure 3-17.2), and groundwater discharge is an important component of streamflow and fish habitat in all three watersheds (USACE 2020a: Pages 3.16-8 and 3.24-4). Groundwater exchange between the SFK and UTC watersheds has been well documented (USACE 2020a: Page 3.17-4).

Use of aquatic habitats by fishes

- Mainstem reaches of the SFK, NFK, and UTC have all been documented to support important salmon spawning aggregations (USACE 2020a: Table 3.24-8; Figures 3.24-6, 3.24-10, and 3.24-13).
- Aquatic habitats within each of the three watersheds provide fishery areas that support reproductively isolated salmon populations (Section 3.3.3), which in turn contribute to valuable subsistence, commercial, and recreational fisheries.

The similarities detailed above do not mean that aquatic resources across the SFK, NFK, and UTC watersheds are interchangeable. The broad components of these headwater watersheds—in terms of the types and abundance of aquatic habitats, their general physical and chemical characteristics, and the organisms that use those habitats—are similar. Within each watershed, however, these component pieces are put together in unique ways, based on the specific characteristics of individual habitats, how those individual habitats are arranged and connected, and how individual organisms move among them. In each of the three watersheds, similar components combine in different ways to create unique habitat mosaics, which over thousands of years have resulted in local adaptation of populations, especially anadromous fish populations, to site-specific conditions in each watershed. As a result, loss or disruption of aquatic habitats in any of the three watersheds would be expected to result in similar impacts on ecological function.

It is important to note that the characterization of aquatic habitat area is limited by resolution of the available NWI data, which tend to underestimate their extents. For example, multiple sources of high-resolution remote imaging and ground-truthing were used to map streams and wetlands at the mine site (USACE 2020a). This high-resolution mapping identifies approximately 400 percent more stream miles than the NHD and approximately 40 percent more wetland acres than the NWI (USFWS 2021) in this area (see Box 4-3 for additional information on water resources mapping at the mine site). However, this high-resolution mapping of aquatic resources is not available for the entire SFK, NFK, and UTC watersheds. Thus, most of the stream length estimates included in this section are based on the most recent iteration of the NHD (USGS 2021b).

3.2.4 Importance of Headwater Stream and Wetland Habitats to Fish

Headwater streams and wetlands are the small channels and wetland areas located in the upstream source areas of river networks. The branched nature of river networks means that watersheds are dominated by headwater streams, in terms of both stream number and stream length (Hill et al. 2014, Callahan et al. 2015). Small headwater streams make up approximately 65 percent of assessed stream length in the SFK, NFK, and UTC watersheds (Table 3-1).[43] Thus, headwater streams—and their associated headwater wetlands—are key habitat features in this region. These headwater systems provide habitat for numerous fish species, as well as supply water, invertebrates, organic matter, and other resources to larger downstream waters. Because of their large influence on downstream water flow, water chemistry, and biota, the importance of headwater systems reverberates throughout entire watersheds downstream (Freeman et al. 2007, Meyer et al. 2007, Fritz et al. 2018, Schofield et al. 2018, Ferreira et al. 2022).

Headwater streams and spring (headwater) wetland habitats are particularly important in establishing and maintaining fish diversity (Cummins and Wilzbach 2005, Colvin et al. 2019). They support resident fish assemblages, as well as provide key habitats for specific life stages of migratory fishes. For example, headwaters provide spawning and nursery areas for fish species that use larger streams, rivers, and lakes for most of their freshwater life cycles (e.g., Pacific salmon and Rainbow Trout) (Quinn 2018). The use of headwater streams and wetlands by a variety of fish species has been observed in many aquatic ecosystems (see Meyer et al. 2007 for a thorough review). Headwater streams in southeastern Alaska can be an important source area for downstream Dolly Varden populations (Bryant et al. 2004). Foley et al. (2018) examined the distribution of juvenile Coho Salmon in three headwater streams of the Little Susitna River, Alaska; they found that juveniles occurred throughout these headwater streams where stream gradients were less than 4 to 5 percent. In the Nushagak and Kvichak River watersheds, 96 percent of 108 surveyed headwater streams contained fishes, including rearing Coho and Chinook salmon, adult Coho and Sockeye salmon, Rainbow Trout, Dolly Varden, Arctic Grayling, Round Whitefish, Burbot, and Northern Pike (Woody and O'Neal 2010).

[43] Based on the 2012 iteration of the NHD (USGS 2012); total mapped stream length in the SFK, NFK, and UTC watersheds changed by only 1 percent between the 2012 and 2021 iterations of the NHD.

Summer and early fall can provide opportunities for maximum growth for juvenile salmon rearing in headwater systems, as both stream temperatures and food availability increase (Quinn 2018). Although seasonal fish distribution patterns are poorly understood for the region, lower-gradient headwater streams and associated wetlands may also provide important habitat for stream fishes during other seasons. Thermally diverse habitats in off-channel wetlands can provide rearing and foraging conditions that may be unavailable in the mainstream channel, increasing capacity for juvenile salmon rearing (Brown and Hartman 1988, Nickelson et al. 1992, Cunjak 1996, Collen and Gibson 2001, Sommer et al. 2001, Henning et al. 2006, Lang et al. 2006, PLP 2011). Loss of wetlands in more developed regions has been associated with reductions in habitat quality and salmon abundance, particularly for Coho Salmon (Beechie et al. 1994, Pess et al. 2002).

Winter habitat availability for juvenile rearing has been shown to limit salmonid productivity in streams of the Pacific Northwest (Nickelson et al. 1992, Solazzi et al. 2000, Pollock et al. 2004), and may be limiting for fishes in the SFK, NFK, and UTC watersheds given the relatively cold temperatures and long winters in the region (Morrow 1980, Reynolds 1997). Overwintering habitats for stream fishes must provide suitable instream cover, dissolved oxygen, and protection from freezing (Cunjak 1996). Beaver ponds and groundwater upwelling areas in headwater streams and wetlands in the SFK, NFK, and UTC watersheds likely meet these requirements. In winter, beaver ponds typically retain liquid water below the frozen surface, creating important winter refugia for stream fishes (Cunjak 1996). Beaver ponds provide excellent habitat for rearing salmon by trapping organic materials and nutrients and creating structurally complex, large-capacity pool habitats with potentially high macrophyte cover, low streamflow velocity, and/or moderate temperatures (Nickelson et al. 1992, Collen and Gibson 2001, Pollock et al. 2004, Lang et al. 2006). Additionally, beaver dams, including ponds at a variety of successional stages, provide a mosaic of habitats for not just salmon but other fish and wildlife species (e.g., lamprey).

An October 2005 aerial survey of active beaver dams in the Pebble deposit area mapped 113 active beaver colonies (PLP 2011: Chapter 16:16.2-8). As detailed in Section 3.2.2, the SFK, NFK, and UTC watersheds are dominated by low-gradient headwater streams. Beavers preferentially colonize headwater streams—particularly those with gradients less than 6 percent—because of their shallow depths and narrow widths (Collen and Gibson 2001, Pollock et al. 2003). Beaver ponds provide important and abundant habitat within the Pebble deposit area and may be particularly important for overwinter rearing of species such as Coho Salmon and for providing deeper pool habitats for additional species during low streamflow conditions (PLP 2011: Appendix 15.1D, USACE 2020a: Section 3.24).

The lateral expansion of floodplain wetland habitats during flooding greatly influences habitat connectivity by determining whether and for how long fishes can reach newly created or existing habitats (Bunn and Arthington 2002). In the Bristol Bay watershed, field observations have indicated the presence of salmon in stream sites disconnected from surface-water flows (Woody and O'Neal 2010). Annual floods during spring and fall likely reconnect these habitats through a network of ephemeral wetlands and streams. The use of these temporary stream and wetland habitats by fishes is

not well understood in the Bristol Bay watershed, but they appear to be important in establishing habitat connectivity.

Inputs of groundwater-influenced streamflow from headwater tributaries likely benefit fishes by moderating mainstem temperatures and contributing to thermal diversity in downstream waters (Cunjak 1996, Power et al. 1999, Huusko et al. 2007, Armstrong et al. 2010, Brown et al. 2011, Ebersole et al. 2015). Such thermal diversity can be an important attribute of stream systems in the region, providing localized water temperature patches that may offer differing trade-offs for species bioenergetics. For example, salmon may select relatively cold-temperature sites—often associated with groundwater upwelling—for spawning, whereas juvenile salmon rearing in those same streams may take advantage of warm-temperature patches for optimal food assimilation (Armstrong and Schindler 2013). Headwater streams in the SFK and NFK watersheds may provide a temperature-moderating effect and serve as sources of thermal heterogeneity, providing cooler temperatures in summer and warmer temperatures in winter.

It has long been recognized that, in addition to providing habitat for stream fishes, headwater streams and wetlands serve an important role in the stream network by contributing water, nutrients, organic material, macroinvertebrates, algae, and bacteria downstream to higher-order streams in the watershed (Vannote et al. 1980, Meyer et al. 2007, Doretto et al. 2020). This is particularly true in dendritic stream networks like the SFK, NFK, and UTC systems, which have a high density of headwater streams. For example, Koenig et al. (2019) found that small streams with relatively low primary productivity can exert a disproportionate effect on overall gross primary productivity in the river network, due to the large collective surface area of these small channels. Because of their narrow width, headwater streams also receive proportionally greater inputs of organic material from the surrounding terrestrial vegetation than larger stream channels (Vannote et al. 1980, Doretto et al. 2020). This material is either used locally (Tank et al. 2010) or transported downstream to larger streams in the network (Wipfli et al. 2007).

Headwater streams—including streams with only intermittent or ephemeral flow—are important suppliers of invertebrates and detritus to downstream areas that support juvenile salmonids and other fishes (Wipfli and Gregovich 2002, Cummins and Wilzbach 2005, Colvin et al. 2019, Hedden and Giddo 2020). In transporting these materials downstream, headwaters provide an important energy subsidy for juvenile salmonids (Wipfli and Gregovich 2002). For example, Wipfli and Gregovich (2002) found that fishless headwater streams in southeastern Alaska were a year-round source of invertebrate prey for salmonids. They estimated that these streams could provide downstream salmonid-bearing habitat with enough invertebrate prey and detritus to support up to 2,000 juvenile salmonids per kilometer (Wipfli and Gregovich 2002). Recent experimental studies have also shown that disturbance and degradation of small tributaries can affect invertebrate populations in downstream reaches (Chará-Serna and Richardson 2021, González and Elosegi 2021).

The export value of headwater streams can be influenced by the surrounding vegetation. For example, riparian alder (a nitrogen-fixing shrub) was positively related to aquatic invertebrate densities and the

export rates of invertebrates and detritus in southeastern Alaska streams (Piccolo and Wipfli 2002, Wipfli and Musslewhite 2004). Riparian vegetation in the Pebble deposit area is dominated by deciduous shrubs such as willow and alder (USACE 2020a: Section 3.24); thus, these streams are likely to provide abundant, high-quality detrital inputs to downstream reaches.

Headwater streams can also have high instream rates of nutrient processing and storage, thereby influencing downstream water chemistry due to relatively large organic matter inputs, high retention capacity, high primary productivity, bacteria-induced decomposition, and/or extensive hyporheic zone interactions (Richardson et al. 2005, Alexander et al. 2007, Meyer et al. 2007). In examining network-wide patterns in water chemistry of the Kuskokwim River, Alaska, French et al. (2020) found that watershed attributes of headwaters were the best predictor for almost all streamwater constituents (e.g., nitrate, phosphate, dissolved organic carbon) across the entire network. They concluded that headwaters are governing river biogeochemistry in this system (French et al. 2020). Similarly, when the natural flow regimes of headwater streams are altered, adverse effects on downstream water quality often occur (Colvin et al. 2019). Accurate assessment of these physical and chemical connections between headwaters and downstream waters—and perhaps more important, their consequences for the integrity of those downstream waters—should consider aggregate connections over multiple years to decades (Fritz et al. 2018).

In summary, headwater streams and wetlands play a vital role in maintaining diverse, abundant fish populations, both by providing important fish habitat and by supplying the energy and other resources needed to support fishes in connected downstream habitats (Colvin et al. 2019). Headwater streams and wetlands are abundant in the Pebble deposit area and play a crucial role in supporting local and downstream fish populations.

3.3 Fish Resources

Given the abundant, diverse, and high-quality freshwater habitats found in the Nushagak and Kvichak River watersheds, it is not surprising that this region supports world-class fishery resources. This section considers the fish species found in the Nushagak and Kvichak River watersheds, with particular focus on the SFK, NFK, and UTC watersheds; life-history, distribution, and abundance information for these species; the ecological importance of these fish populations, in terms of both maintaining biocomplexity and diversity at local and global scales and providing nutrient subsidies to habitats; and the importance of subsistence, commercial, and recreational fisheries in the region. As this section illustrates, this region supports a robust, diverse fish assemblage of considerable ecological, economic, and cultural value, and loss of these fish resources could have significant repercussions.

3.3.1 Species and Life Histories

The Bristol Bay watershed is home to at least 29 fish species, representing at least nine different families. The 29 species documented to occur in the Nushagak and Kvichak River watersheds, as well as information on their migratory patterns and general abundance, habitat types, and predator-prey

relationships, are listed in Table 3-3. At least 20 of these species are known to inhabit the SFK, NFK, and UTC watersheds (USACE 2020a: Section 3.24). The region is renowned for its fish populations, and it supports world-class fisheries for multiple species of Pacific salmon and other subsistence and game fishes (Dye and Borden 2018, Halas and Neufeld 2018). These resources generate significant benefit for commercial fishers (Section 3.3.5), provide nutritional and cultural sustenance for Alaska Native populations and other residents (Section 3.3.6), and support valued recreational fisheries (Section 3.3.7).

Five species of Pacific salmon spawn and rear in the Bristol Bay watershed's freshwater habitats: Coho or Silver salmon, Chinook or King salmon, Sockeye or Red salmon, Chum or Dog salmon, and Pink or Humpback salmon. Because no hatchery fishes are raised or released in the watershed, the Bristol Bay region supports entirely wild, naturally sustainable fisheries (Section 3.1).

All five salmon species share life-history traits that contribute to their success and significance in the Bristol Bay region. First, they are anadromous: they hatch in freshwater habitats, migrate to sea for a period of relatively rapid growth, and then return to freshwater habitats to spawn. Second, the vast majority of adults undergo extensive homing migrations to return to their natal freshwater habitats to spawn. Salmon imprint on the chemical signatures of their natal sites throughout their early development (Dittman and Quinn 1996, Ueda 2019), then use olfactory and other cues to migrate back to these locations as adults. This homing behavior fosters reproductive isolation, creating distinct, localized populations that are uniquely adapted to the specific environmental conditions of their natal habitats (Blair et al. 1993, Dittman and Quinn 1996, Ramstad et al. 2010, Eliason et al. 2011, Zwollo 2018, Smith and Zwollo 2020) (Section 3.3.3). Finally, each species is semelparous: adults return to their natal streams to spawn once and then inevitably die. Because adults only have one opportunity to reproduce, spawning site selection is a critical determinant of their reproductive fitness. Upon their death, adult salmon release the nutrients incorporated in their bodies into their spawning habitats; this slow release of marine-derived nutrients provides critical resources for their offspring and many other organisms (Section 3.3.4).

The seasonality of spawning and incubation is roughly the same for all five Pacific salmon species, although the timing can vary somewhat by species, population, and region. For example, Coho Salmon tend to spawn later in the season and have shorter incubation periods (Spence 1995), whereas Sockeye and Chinook salmon tend to return and spawn earlier in the season. In general, salmon spawn from summer through fall, and fry emerge from spawning gravels the following spring to summer. Freshwater habitats used for spawning and rearing vary across and within species, and include headwater streams, larger mainstem rivers, side- and off-channel wetlands, spring-fed ponds, and lakes (Table 3-4; Section 3.3.3). Use of lakes is common among salmonids (Arostegui and Quinn 2019a). Sockeye Salmon are unique among the Pacific salmon species in that most populations rely on lakes as the primary freshwater rearing habitat ("lake-type" Sockeye Salmon) (Table 3-4), although there are populations in the Bristol Bay watershed that rear in small streams and rivers ("river-type" Sockeye Salmon) (Section 3.3.3).

Table 3-3. Fish species reported in the Nushagak and Kvichak River watersheds. Species in bold have been documented to occur in aquatic habitats within the South Fork Koktuli River, North Fork Koktuli River, and Upper Talarik Creek watersheds. (H) indicates species considered to be harvested—that is, they are well-distributed across the Nushagak and Kvichak River watersheds and are or have been targeted by subsistence, commercial, or recreational fisheries. This list does not include primarily marine species that periodically venture into the lower reaches of coastal streams.

Family	Species	Migratory Pattern(s) [a]	Relative Abundance	Predator–Prey Relationships [b]
Salmonids (Salmonidae)	Bering Cisco *(Coregonus laurettae)*	N and A	Very few specific reports	-
	Humpback Whitefish (H) *(C. pidschian)*	N and A	Common in large lakes; locally and seasonally common in large rivers	Feed primarily on aquatic invertebrates (mollusks, insect larvae), also salmon eggs and small fry Eaten by other fishes (Northern Pike, Lake Trout); eggs eaten by Round Whitefish, Arctic Grayling)
	Least Cisco *(C. sardinella)*	N and A	Locally common in some lakes (e.g., Lake Clark, morainal lakes near Iliamna Lake); less common in Iliamna Lake and large slow-moving rivers, such as the Chulitna, Kvichak, and lower Alagnak	Feed on aquatic invertebrates (insect larvae, copepods) Eaten by other fishes (Lake Trout, Northern Pike, Burbot) and fish-eating birds
	Pygmy Whitefish *(Prosopium coulterii)*	N	Locally common in a few lakes or adjacent streams	Feed on aquatic invertebrates (insect larvae, zooplankton, mollusks) and whitefish eggs Eaten by other fish (Lake Trout, Arctic Char, Dolly Varden) and fish-eating birds
	Round Whitefish *(P. cylindraceum)*	N	Abundant/widespread throughout larger streams in upland drainages; not found in headwaters or coastal plain areas	Feed on aquatic invertebrates (insect larvae, snails) and salmon and whitefish eggs Eaten by other fishes (Burbot, Lake Trout, Northern Pike)
	Coho Salmon (H) *(Oncorhynchus kisutch)*	A	Juveniles abundant/widespread in flowing waters of Nushagak River watershed and in some Kvichak River tributaries downstream of Iliamna Lake; present in some Iliamna Lake tributaries; not recorded in the Lake Clark watershed	Juveniles feed primarily on aquatic invertebrates (insect larvae) and salmon eggs and carcasses
	Chinook Salmon (H) *(O. tshawytscha)*	A	Juveniles abundant and widespread in upland flowing waters of Nushagak River watershed and in Alagnak River; infrequent upstream of Iliamna Lake	Juveniles feed primarily on aquatic invertebrates (insect larvae)
	Sockeye Salmon (H) *(O. nerka)*	A	Abundant	Juveniles feed primarily on zooplankton
	Chum Salmon (H) *(O. keta)*	A	Abundant in upland flowing waters of Nushagak River watershed and in some Kvichak River tributaries downstream of Iliamna Lake; rare upstream of Iliamna Lake	-

Family	Species	Migratory Pattern(s) [a]	Relative Abundance	Predator–Prey Relationships [b]
	Pink Salmon (H) *(O. gorbuscha)*	A	Abundant (in even years), with restricted distribution, in the Nushagak River watershed and in some Kvichak River tributaries downstream of Iliamna Lake; rare upstream of Iliamna Lake	-
	Rainbow Trout (H) *(O. mykiss)*	N [c]	Frequent/common; in summer, closely associated with spawning salmon	Feed on aquatic invertebrates (insect larvae), terrestrial invertebrates, sockeye salmon eggs, and salmon carcasses Eaten by other fishes; eggs eaten by Slimy Sculpin
	Arctic Char (H) *(Salvelinus alpinus)*	N	Locally common in upland lakes	Feed on aquatic invertebrates (insect larvae, snails, mollusks) and fishes (Threespine Stickleback, sculpin) Eaten by other fishes (Lake Trout, larger Arctic Char)
	Dolly Varden (H) *(S. malma)*	N and A	Abundant in upland headwaters and selected lakes	Feed on aquatic invertebrates (insect larvae, zooplankton), terrestrial invertebrates, juvenile salmon, and salmon eggs Eaten by larger Dolly Varden, Lake Trout, and terrestrial predators (River Otters, fish-eating birds)
	Lake Trout (H) *(S. namaycush)*	N	Common in larger upland lakes and seasonally present in lake outlets; absent from the Wood River lakes	Feed on aquatic invertebrates when small and fishes (Least Cisco, salmon, Arctic Grayling, many others) when large Eaten by other fishes (Burbot, large Lake Trout); eggs eaten by other fish (Slimy Sculpin, Round Whitefish, other Lake Trout)
	Arctic Grayling (H) *(Thymallus arcticus)*	N	Abundant/widespread	Feed on aquatic and terrestrial invertebrates and salmon eggs Eaten by Lake Trout and Dolly Varden
Lampreys (Petromyzontidae)	**Arctic Lamprey** [d] *(Lethenteron camtschaticum)*	A	Juveniles common/widespread in sluggish flows where fine sediments accumulate	Feed on detritus and salmon carcasses Eaten by rainbow trout, other fish, birds, and mammals
	Alaskan Brook Lamprey [d] *(L. alaskense)*	N		
	Pacific Lamprey *(Entosphenus tridentatus)*	A	Rare	
Suckers (Catostomidae)	Longnose Sucker *(Catostomus catostomus)*	N	Common in slower flows of larger streams	Feed on aquatic invertebrates and plants Eaten by other fish (Lake Trout, Northern Pike, Burbot) and River Otters
Pikes (Esocidae)	**Northern Pike** (H) *(Esox lucius)*	N	Common/widespread in still or sluggish waters	Feed on aquatic invertebrates when small (insect larvae, zooplankton) and fishes when large (salmon, Arctic Char, Lake Trout, many others)

Family	Species	Migratory Pattern(s) [a]	Relative Abundance	Predator–Prey Relationships [b]
Mudminnows (Umbridae)	Alaska Blackfish *(Dallia pectoralis)*	N	Locally common/abundant in still or sluggish waters in flat terrain	Feed on aquatic invertebrates (copepods, cladocerans, insect larvae, snails) and algae Eaten by Northern Pike and larger Alaska Blackfish
Smelts (Osmeridae)	**Rainbow Smelt** *(Osmerus mordax)*	A	Seasonally abundant in streams near the coast	Feed on aquatic invertebrates and fishes (Slimy Sculpin) Eaten by fish-eating birds, Rainbow Trout, and River Otters
	Pond Smelt *(Hypomesus olidus)*	N	Locally common in coastal lakes and rivers, Iliamna Lake, inlet spawning streams, and the upper Kvichak River; abundance varies widely interannually	Feed primarily on zooplankton Eaten by other fishes (Arctic Char, Lake Trout)
	Eulachon *(Thaleichthys pacificus)*	A	No or few specific reports; if present, distribution appears limited and abundance low	-
Cods (Gadidae)	**Burbot** *(Lota lota)*	N	Infrequent to common in deep, sluggish, or still waters	Feed on aquatic invertebrates when small (insect larvae) and fishes when large (Least Cisco, Lake Trout, sculpin, Round Whitefish) Eaten by other fishes (larger Burbot)
Sticklebacks (Gasterosteidae)	**Threespine Stickleback** *(Gasterosteus aculeatus)*	N and A	Locally abundant in still or sluggish waters; abundant in Iliamna Lake	Feed on aquatic invertebrates (cladocerans, copepods, amphipods) Eaten by other fishes (Arctic Char, Northern Pike, Rainbow Trout, others), fish-eating birds, and large aquatic invertebrates (predatory insect larvae)
	Ninespine Stickleback *(Pungitius pungitius)*	N	Abundant/widespread in still or sluggish waters	
Sculpins (Cottidae)	Coastrange Sculpin *(Cottus aleuticus)*	N	Abundant/widespread [e]	Feed on aquatic invertebrates (insect larvae) and salmon eggs, alevins, and fry Eaten by other fishes (salmon fry, Burbot, Humpback Whitefish, Northern Pike, others)
	Slimy Sculpin *(C. cognatus)*	N		

Notes:

[a] A = anadromous (fishes that spawn in freshwaters and migrate to marine waters to feed); N = non-anadromous (fishes that spend their entire life in fresh waters, with possible migrations between habitats within a watershed). N and A indicates fishes in which some individuals have non-anadromous and some have anadromous migratory patterns.

[b] For anadromous species, only predator-prey relationships in freshwater habitats are presented. Dash (-) indicates either that the species is rare and detailed information is not available for the region, or that the species spends limited time in fresh water (i.e., for Pink and Chum salmon).

[c] In the Bristol Bay watershed, anadromous individuals (Steelhead) are known to spawn and rear only in the North Alaska Peninsula watershed.

[d] Juveniles of these two species, which are the most commonly encountered life stages in these watersheds, are indistinguishable. Both species are present in the watershed, but it is possible that all documented occurrences are for one of these species.

[e] These species are combined here, because they are not reliably distinguished in field conditions, although Slimy Sculpin is thought to be more abundant and widely distributed.

Source: EPA 2014, USACE 2020a: Table 3.24-11; see Appendix B, Table 1 in EPA (2014) for references and additional information on the abundance and life history of each species.

Table 3-4. Life history, habitat characteristics, and total documented stream length occupied for Bristol Bay's five Pacific salmon species in the Nushagak and Kvichak River watersheds.

Salmon Species	Freshwater Rearing Period (years)	Freshwater Rearing Habitat	Ocean-Feeding Period (years)	Spawning Habitat	Documented Stream Length Occupied (miles)
Coho	1–3	Headwater streams to moderate-sized rivers, headwater springs, beaver ponds, side channels, sloughs	1+	Headwater streams to moderate sized rivers	4,470
Sockeye	0–3	Lakes, rivers	2–3	Beaches of lakes, streams connected to lakes, larger braided rivers	3,174
Chinook	1+	Headwater streams to large-sized mainstem rivers	2–4	Moderate-sized streams to large rivers	3,108
Chum	0	Limited	2–4	Moderate-sized streams and rivers	2,170
Pink	0	Limited	1+	Moderate-sized streams and rivers	1,334

Source: EPA 2014: Appendix A (life history and habitat characteristics), the Anadromous Waters Catalog (Giefer and Graziano 2022) (stream lengths).

With some exceptions, preferred spawning habitat consists of gravel-bedded stream reaches of moderate water depth (12 to 24 in [30 to 60 cm]) and current (12 to 40 in/s [30 to 100 cm/s]) (Quinn 2018). In Alaska, studies have also found groundwater exchange to be of key importance for spawning salmon site selection (MacLean 2003, Curran et al. 2011, Mouw et al. 2014, McCracken 2021).

Both Chum and Pink salmon migrate to the ocean soon after fry emergence (Heard 1991, Salo 1991). Because Coho, Chinook, and Sockeye salmon spend a year or more rearing in the Bristol Bay watershed's streams, rivers, and lakes before their ocean migration (Table 3-4), these species depend more on upstream freshwater resources than do Chum and Pink salmon.

In addition to the five Pacific salmon species, the Bristol Bay region is home to at least 24 resident fish species, most of which typically (but not always) remain within the watershed's freshwater habitats throughout their life cycles. The region contains highly productive waters for such subsistence and sport fish species as Rainbow Trout,[44] Dolly Varden, Arctic Char, Arctic Grayling, Humpback Whitefish, Northern Pike, and Lake Trout, as well as numerous other species that are not typically harvested (Table 3-3). These fish species occupy a variety of habitats throughout the watershed, including headwater streams, rivers, off-channel habitats, wetlands, and lakes.

Given the importance of Rainbow Trout, Dolly Varden, and Northern Pike that rely on salmon populations to both subsistence and sport fisheries (Sections 3.3.6 and 3.3.7), it is worth considering key life-history and habitat-use traits of these species. The spawning habitat and behavior of Rainbow Trout are generally similar to those of the Pacific salmon species, with a few key exceptions. First, Rainbow Trout are iteroparous, meaning that they can spawn repeatedly. Second, spawning occurs in spring,

[44] The species *O. mykiss* includes both a non-anadromous or resident form (commonly referred to as Rainbow Trout) and an anadromous form (commonly referred to as Steelhead). In the Bristol Bay watershed, Steelhead generally are restricted to a few spawning streams near Port Moller, on the Alaska Peninsula.

versus summer and early fall for salmon. Juveniles emerge from spawning gravels in summer (Johnson et al. 1994, ADF&G 2022a), and immature fishes may remain in their natal streams for several years before migrating to other freshwater habitats (Russell 1977).

Rainbow Trout in the Bristol Bay watershed exhibit complex migratory patterns, moving between spawning, rearing, feeding, and overwintering habitats. For example, many adults in the region spawn in inlet or outlet streams of large lakes, then migrate shortly after spawning to feeding areas within those lakes. Some mature fishes may seasonally move distances of 120 miles (200 km) or more (Russell 1977, Burger and Gwartney 1986, Minard et al. 1992, Meka et al. 2003). Often, these migratory patterns ensure that Rainbow Trout are in close proximity to the eggs and carcasses of spawning salmon, which provide an abundant, high-quality food resource (Meka et al. 2003). The variety of habitat types used by Rainbow Trout is reflected by different life-history types identified in the region, including lake, lake-river, and river residents (Meka et al. 2003).

Dolly Varden is a highly plastic fish species, with multiple genetically, morphologically, and ecologically distinct forms that can co-exist in the same waterbodies (Ostberg et al. 2009). Both anadromous and non-anadromous Dolly Varden are found in the Bristol Bay watershed, and both life-history forms can exhibit complex and extensive migratory behavior (Armstrong and Morrow 1980, Reynolds 2000, Scanlon 2000, Denton et al. 2009, Hart et al. 2015, Chin et al. 2022). Anadromous individuals usually undertake three to five ocean migrations before reaching sexual maturity (DeCicco 1992, Lisac and Nelle 2000, Crane et al. 2003). During these migrations, Dolly Varden frequently leave one drainage, travel through marine waters, and enter a different, distant drainage (DeCicco 1992, DeCicco 1997, Lisac 2009). Non-anadromous individuals also may move extensively between different habitats (Scanlon 2000).

Dolly Varden spawning occurs in fall, upstream of overwintering habitats (DeCicco 1992). Northern-form anadromous Dolly Varden (the geographic form of Dolly Varden found north of the Alaska Peninsula) overwinter primarily in lakes and in lower mainstem rivers where sufficient groundwater provides suitable volumes of free-flowing water (DeCicco 1997, Lisac 2009). Within the Nushagak and Kvichak River watersheds, juveniles typically rear in low-order, high-gradient stream channels (ADF&G 2022a). Because Dolly Varden occur in headwater lakes and high-gradient headwater streams (ADF&G 2022a)—farther upstream than many other fish species and above migratory barriers to anadromous salmon populations—they may be especially vulnerable to habitat degradation in these headwater areas. Like Rainbow Trout, Dolly Varden rely on salmon-derived food resources such as salmon eggs and carcasses, as well as invertebrates feeding on those carcasses (Denton et al. 2009, Denton et al. 2010, Jaecks and Quinn 2014).

Northern Pike primarily spawn in sections of lakes, wetlands, or very low-gradient streams that provide shallow (<3 feet [1 m]), slow, or still waters with aquatic vegetation and soft substrates (EPA 2014: Appendix B). Their summer habitat is typically deeper but still relatively warm water with dense aquatic vegetation. Northern Pike overwinter in lakes, spring-fed rivers, and larger deep rivers where water and oxygen are sufficient for survival until spring (EPA 2014: Appendix B). In spring, mature Northern Pike ascend tributaries, beneath the ice, to reach spawning areas, then move to deeper waters to feed. Fry

remain near or downstream of spawning areas. Many mature Northern Pike do not travel far, but some river-system individuals make extensive seasonal migrations—sometimes as far as 180 miles (290 km) per year—between spawning, feeding, and overwintering areas (EPA 2014: Appendix B).

Table 3-3 provides summary information on the other 21 fish species that have been documented in the Nushagak and Kvichak River watersheds. It is important to note that none of these species exists in isolation—rather, they together make up diverse fish assemblages that interact with each other in numerous ways. For example, sculpins, Dolly Varden, and Rainbow Trout consume salmon eggs and emergent fry (including lamprey ammocoetes), and Northern Pike can be effective predators of juvenile salmon and other fish species (Sepulveda et al. 2013, Schoen et al. 2022). Insectivorous and planktivorous fishes may compete with juvenile salmonids for food (e.g., Hartman and Burgner 1972). These types of prevalent interactions among species mean that impacts on any one fish species could affect the entire assemblage.

3.3.2 Distribution and Abundance

As Section 3.3.1 illustrates, the Nushagak and Kvichak River watersheds in general—and the SFK, NFK, and UTC watersheds in particular—support a robust assemblage of fishes, including several species that support valuable subsistence, commercial, and recreational fisheries (Sections 3.3.5 through 3.3.7). These fishes use a diversity of freshwater habitats throughout their life cycles. Fish populations across the Bristol Bay watershed have not been sampled comprehensively, so estimates of total distribution and abundance across the region are not available. All fish distribution maps included here represent the currently documented distributions for each species, based on the AWC (Giefer and Graziano 2022) and the AFFI (ADF&G 2022a). Note that species absence cannot be inferred from these maps, as areas without documented occurrence of a species may not have been sampled; however, available data[45] provide at least minimum estimates of where key species are found and how many individuals of those species have been caught.[46] More information on the distribution and abundance of key fish species can be found in Section 3.24 of USACE (2020a) and Appendices A and B of the BBA (EPA 2014).

3.3.2.1 Nushagak and Kvichak River Watersheds

Most (72 percent) of the smaller watersheds within the Nushagak and Kvichak River watersheds are documented to contain at least one species of spawning or rearing salmon within their boundaries; 19 percent are documented to contain all five species (Figure 3-1). Reported distributions for the five salmon species in the Nushagak and Kvichak River watersheds are shown in Figure 3-2.

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[45] Notable sources of data include the AWC (Giefer and Graziano 2022), AFFI (ADF&G 2022a), and fish escapement and harvest data. The AWC is the State of Alaska's official record of anadromous fish distributions and, if available, the life stages present (categorized as spawning, rearing, or present but life stage unspecified). The AFFI includes all fish species found at specific sampling points; some observers also documented life stage (adult or juvenile).

[46] See Appendix B of this document for additional information on the interpretation of available fish distribution data.

Coho Salmon spawn and rear in many stream reaches throughout the Nushagak and Kvichak River watersheds. Juveniles distribute widely into headwater streams, where they are often the only salmon species present (Woody and O'Neal 2010, King et al. 2012). Because Coho Salmon spend 1 to 3 years in fresh water, rearing habitat in headwater streams can be an especially important factor influencing their productivity (Nickelson et al. 1992, Solazzi et al. 2000).

Chinook Salmon spawn and rear throughout the Nushagak River watershed and in several tributaries of the Kvichak River. Although Chinook Salmon is the least common salmon species across the Bristol Bay region, the Nushagak River watershed supports a large Chinook Salmon fishery: on average, more than 75 percent of Bristol Bay's commercial Chinook Salmon catch comes from the Nushagak fishing district (Section 3.3.5). Chinook Salmon returns to the Nushagak River are consistently greater than 100,000 fish per year and have exceeded 200,000 fish per year in 11 years between 1966 and 2010, which places the Nushagak River at or near the size of the world's largest Chinook Salmon runs (EPA 2014: Chapter 5). In recent years, Nushagak River Chinook Salmon have failed to meet their established escapement goal (i.e., the number of adult salmon that "escape" harvest and return to freshwaters to spawn). In October 2022, ADF&G recommended that Nushagak River Chinook Salmon be designated as a stock of management concern (ADF&G 2022f), highlighting the importance of the species in this region.

Sockeye Salmon is by far the most abundant salmon species in the Bristol Bay watershed (Tiernan et al. 2021).[47] Between 2010 and 2019, the average annual inshore run of Sockeye Salmon was 17.9 million fish in the Naknek-Kvichak district and 12.9 million fish in the Nushagak district (Tiernan et al. 2021). Tributaries to Iliamna Lake, Lake Clark, and, in the Nushagak River watershed, the Wood-Tikchik Lakes are major Sockeye Salmon spawning areas, and juveniles rear in each of these lakes. Iliamna Lake provides the majority of Sockeye Salmon rearing habitat in the Kvichak River watershed and historically has produced more Sockeye Salmon than any other lake in the Bristol Bay region (Fair et al. 2012). Riverine Sockeye Salmon populations spawn and rear throughout the Nushagak River watershed.

Chum Salmon is the second most abundant salmon species in the Nushagak and Kvichak River watersheds. Both Chum and Pink salmon spawn throughout the Nushagak and Kvichak River watersheds, but do not have extended freshwater rearing stages.

Extensive sampling for Rainbow Trout, Dolly Varden, Arctic Grayling, Northern Pike, and other fishes has not been conducted throughout the Bristol Bay region, so total distributions and abundances are unknown. Reported occurrences of a subset of these resident fishes, which provide a minimum estimate of their extents throughout the Nushagak and Kvichak River watersheds, are shown in Figures 3-3 and 3-4: Rainbow Trout, Dolly Varden, and Arctic Grayling (Figure 3-3) and Northern Pike, stickleback, and sculpin (Figure 3-4).

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[47] Bristol Bay is home to the largest Sockeye Salmon fishery in the world, with 46 percent of the average global abundance of wild Sockeye Salmon between 1956 and 2005 (Ruggerone et al. 2010, EPA 2014: Figure 5-9A). Between 2010 and 2019, the average annual inshore run of Sockeye Salmon in Bristol Bay was approximately 45.5 million fish (ranging from a low of 24.4 million in 2013 to a high of 63.0 million in 2018) (Tiernan et al. 2021).

Figure 3-1. Diversity of Pacific salmon species production in the Nushagak and Kvichak River watersheds. Counts of salmon species (Coho, Chinook, Sockeye, Chum, and Pink) spawning and rearing, based on the Anadromous Waters Catalog (Giefer and Graziano 2022), are summed by 12-digit hydrologic unit codes.